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METHODS TO EVALUATE SCALES AND SAMPLE SIZE FOR STABLE TASK INVENTORY INFORMATION

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Methods were developed to determine: (1) the stability and redundancy of responses to two job task scales--the continuous Relative Time-Spent scale and the dichotomous Task-Performed scale, (2) the stability of "job types" (i.e., clusters of job incumbents) derived from scale responses, and (3) the change in stability when sample size is reduced. Results indicated that the Task-Performed scale yields stable, meaningful task information (i.e., percentages of personnel performing tasks) from responses by job incumbents, but no practical gain in information is achieved from the

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Relative Time-Spent scale. A better way to collect time-spent data is proposed. Findings also demonstrate that highly stable scale data and cluster solutions are obtainable from samples substantially smaller than those presently administered. The study's empirically developed relationship between sample size and stability can be usefully employed to determine cost-effective sampling for task inventory surveys.

FOREWORD

This study was initiated in response to a request from the Chief of Naval Personnel (Pers-23, Occupational Classification Systems; now Naval Military Personnel Command (NMPC-5)) to develop methods for determining the minimal sample size requirements that will yield stable, useful task inventory data. Within each of the military services, large-scale task inventory surveys are being conducted on a recurring basis. Collecting data from smaller-sized samples, without loss of useful information, would substantially reduce both data acquisition costs (especially in terms of work hours lost by the operational units) and data processing costs.

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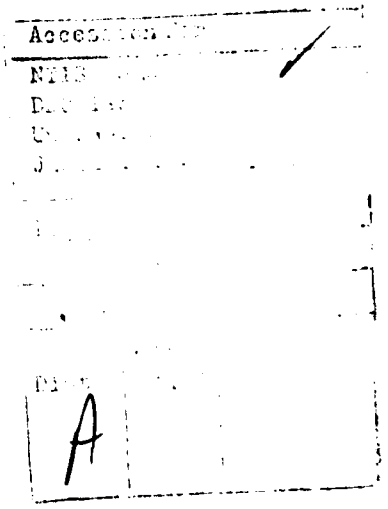

SUMMARY

Problem

Occupational task inventories have been administered to hundreds of thousands of job incumbents in the military service. The collected data are used by management for several important decisions, including the specification of occupational standards, the design of training curricula, and the structuring of occupational specialties. Surveying large numbers of incumbents places heavy time demands on operating units and also results in high data processing costs. Thus, the problem is how to minimize these costs while selecting sample sizes and inventory response scales adequate to obtain stable, useful data.

Objectives

The objectives of this study were to evaluate: (1) the stability and interrelationship of two types of job task scales--the continuous Relative Time-Spent and the dichotomous Task-Performed scales, (2) the stability of "job types" (i.e., clusters of job incumbents) derived from scale responses, and (3) the change in stability when sample size is reduced.

Approach

Scale stability was evaluated by comparing the profiles of average scale scores between randomly split samples for each pay grade of each occupation; and scale interrelationship, by comparing the profiles across scales. Job type (i.e., cluster) stability was evaluated by comparing: (1) score profiles (between clusters), (2) number of tasks performed by incumbents in the clusters, and (3) the "fit" of individual incumbent profiles to the cluster profile. The change in stability with reduced sample size was evaluated using a "pay-off" strategy; that is, instead of seeking a rationale to justify a requirement for a particular level of stability, gains in stability were tracked with increases in sample size. Essentially, if the gains dropped off--if the stability indices became sharply asymptotic--there would be little justification for increasing sample size beyond that point.

The task data analyzed were from four ratings representative of different occupational areas--Aviation Machinist's Mate (AD), Electronics Technician (ET), Torpedoman's Mate (TM), and Yeoman (YN).

Findings

1. The stability of both the continuous (Relative Time-Spent) and dichotomous (Task-Performed) scales was quite high (correlations in the .90s). When average Relative Time-Spent per task (i.e., on the continuous scale) was calculated on only those incumbents actually performing a task (i.e., Relative Time-Spent greater than zero), however, the stability was very low (.30s to .50s).

2. The two types of scales provided highly redundant information, as indicated by the similarity of rank orders of tasks by Relative Time-Spent and Percent Performing profiles (correlations in mid .90s).

3. The average score on each task by the Relative Time-Spent (continuous) scale was generally very small, often less than 1 percent of the total time spent, suggesting that members in a pay grade spend, on the average, less than 1 percent of their time

performing any single task. Essentially, these time estimates are so small because they have been made proportional (or relative) over all tasks responded to in the inventory. Meaningful interpretation of such small values is difficult.

4. High scale stability was obtained for sample sizes substantially smaller than those specified by management. In plotting the stability indices for varying sample sizes, the curves became sharply asymptotic (indicating limited improvement) for pay grade samples greater than 40 (or 140 by a more rigorous criterion).

5. Similarly, cluster solution stability was achieved for occupation samples (total of all pay grades) of 1000, which are substantially smaller than the samples of 2000 or greater presently analyzed.

Conclusions

1. The dichotomous-type Task-Performed scale yields stable, meaningful task information from job incumbent responses. No practical gain in information is achieved from the continuous Relative Time-Spent scale. More informative, more efficiently collected estimates of the time-spent per task could probably be based on incumbents' ranking of a small number of the most time-consuming tasks.

2. Highly stable scale data and cluster solutions are obtainable from samples substantially smaller than those previously administered.

3. This study's empirically developed relationship between sample size and stability can be usefully employed to determine cost-effective sampling for task inventory surveys. For example, for the large occupational populations of Navy ratings alone, use of these aids may reduce the time demands on the fleet by about 52,000 work-hours per cycle of inventory administration.

Recommendations

It is recommended that:

1. The Relative Time-Spent scale be deleted from task analysis inventories.

2. Alternative methods of estimating time spent performing tasks, including ranking of the most time-consuming tasks, be used on a trial basis in task inventory surveys.

3. Responses to a currently administered inventory scale (see page 21) be used to calculate the percentage of incumbents performing each task.

4. This study's empirically developed guidelines for sample size determination be employed.

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INTRODUCTION

Problem

Job information is collected by the military services, on a recurring basis, by administering task inventories (i.e., structured work analysis questionnaires) to large samples of job incumbents. Since the 1960s, more than 800,000 incumbents in the military services have completed inventories that often contain 800 to 1000 items. The data obtained aid management in specifying occupational standards, designing training curricula, and structuring occupational specialties. Sample sizes of Navy personnel administered task inventories range from about 100 to 4000; sample sizes for ratings with large populations (e.g., AD--Aviation Machinist's Mate) tend to be about 2500; and those for ratings with smaller populations (e.g., TM--Torpedoman's Mate), about 500.[1]

Surveying large numbers of incumbents to provide job information results in high data acquisition costs, including work time losses to the operating units and costs incurred from large-scale data processing. Thus, the problem is to select task inventory response scales and sample sizes that will minimize these costs and yet yield stable, useful data.

Background

In selecting useful scales and sample sizes, the type of information to be collected and the analyses to be performed need to be considered. One of the most important types of task information collected by the military services is the estimate of the percentages of personnel performing particular tasks or using specific equipment. This information is used to verify or modify occupational standards and structures by determining the similarity or dissimilarity of tasks performed within different occupational specialties. Another important use of the collected task data is to identify "job types" (i.e., clusters) by grouping persons performing jobs with similar task requirements. The identification of these clusters, for example, can make substantial contributions to training cost-effectiveness by tailoring training courses to the specific types of jobs, thereby providing an objective basis for determining the numbers of students for these courses and the content of the curriculum.

The Navy collects task data by having job incumbents indicate the relevance of each task in the inventory booklet to their particular job by responding to the Relative Time-Spent scale. This scale is a five-point Likert-type scale of time spent on a task, with points ranging from "very much" (a score of 5) to "very little" (a score of 1). The Relative Time-Spent scale responses are converted into scores on two additional scales--a Relative Time-Spent Percentage scale and a dichotomous Task-Performed scale. The former is simply a conversion of the Relative Time-Spent responses to percentages that sum to 100 percent for all tasks performed by an individual (see Appendix A for conversion procedure). The Task-Performed scale is a two-point scale indicating whether an incumbent performs or does not perform a task; that is, the scale score of 1 indicates the task is performed; and a 0, that is is not. The Task-Performed scores of 1 are derived from any response on the Relative Time-Spent scale, while the scores of 0 are derived from any non-response (i.e., blank) on the Relative Time-Spent scale. All references to Relative Time-Spent estimates or scores in the following text will refer to the converted scores (i.e., percentages).

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[1] In the Navy, the term "rating" indicates a basic enlisted occupation (e.g., ST--Sonar Technician) and "service rating" identifies a major class of equipment or systems worked on within a rating (e.g., STS--Sonar Technician (Submarine)). Navy Enlisted Classification Code (NEC) indicates a more specialized skill within or across ratings.

Programs from the Comprehensive Occupational Data Analysis Programs (CODAP) (Weissmuller, Barton, & Rogers, 1974) are applied to the scale data to derive the following job description profiles:

1. MP--Percent of Members Performing (each task).
2. TSM--Average Percent Time-Spent by All Members.
3. TSMP--Average Percent Time-Spent by Members Performing (each task).

The scales, job description profiles, and the CODAP hierarchical clustering procedure used to group persons performing similar work are described in Appendix A.

Standard formulae to determine sample size requirements for collecting survey data have been available for some time (Cochran, 1953; Parten, 1950). These procedures, however, require an estimate of the population variance (often not easily estimated), and sampling assumptions that are not easily met by operational surveys. Also, they are limited in that they are not appropriate for estimating multivariate population parameters (e.g., scale response rates for more than one task in an inventory, or characteristics of multivariate cluster solutions--however, see Frankel, 1971; Moonan, 1954; and Wolfe, 1970). Because of these requirements and the limitation, and because the specific characteristics or properties of data do affect the results of analyses, the present study analyzed the stability of samples of real data.

Purpose

The purpose was to determine empirically the relationship of sample size to stability of incumbents' inventory scale responses. Questions specifically addressed were:

1. What is the stability and interrelationship of two kinds of occupational task inventory scales--Relative Time-Spent and Task-Performed?

2. What is the stability of cluster solutions that use, as input data, scale responses by individual job incumbents?

3. What changes occur in stability indices when sample sizes are reduced?

METHOD

Data

Relative Time-Spent data for inventory tasks were provided by the Navy Occupational Development and Analysis Center (NODAC). The data were from four ratings representative of different occupational areas--Aviation Machinist's Mate (AD), Electronics Technician (ET), Torpedoman's Mate (TM), and Yeoman (YN) (see Table 1). The data had been collected from a variety of Fleet and Shore activities, although instructor and student billets were not sampled. Each of the four rating samples contained data from eight different pay grades, E-2 through E-9. These data comprised the populations (referred to as "Total Sample") from which samples were drawn for analysis. Task data for entire rating populations do not exist. Thus, findings based on NODAC samples provide the best available guidelines for sample sizes required for rating populations. Appendix B presents sample and population sizes by pay grade (Table B-1), and the types of units sampled for the AD and ET ratings (Table B-2).

Table 1

Task Inventory Sizes for Four Navy Ratings

Rating		Inventory Size[a]			
Title	Abbreviation	Total Items	Tasks	Administration Date	
Aviation Machinist's Mate	AD	1163	404	August	1974
Electronics Technician	ET	1080	597	June	1975
Torpedoman's Mate	TM	782	337	March	1975
Yeoman	YN	810	529	August	1975

[a]The task item section (i.e., statements of work performed) was analyzed. Other inventory sections include biographical, job satisfaction, and equipment items.

Sampling Procedure

A set of samples was created from the total sample for these ratings (see Table 2), using a systematic random sampling procedure described by Kish (1965). Sampling was performed within each pay grade of each rating or service rating to assure a similar proportion within pay grade across samples (because of pay grade importance in determining occupational requirements and in other management decisions). Pairs of independent samples (i.e., no individual was included in both samples of the pair) were created by randomly splitting one of the next larger samples, rather than sampling from two different larger samples. For example, in Table 2, the two N = 250 independent AD samples were both drawn from one of the N = 500 samples. Hereafter, the samples will be referred to by the rating (or service rating) abbreviation and sample size (e.g., the AD250 samples, TM368 samples, ETN504 samples). A and B denote any two equal-sized, independent rating samples. Table 2 also shows the holdout groups that were drawn for a specific analysis.

To determine the stability of scores on the Relative Time-Spent and Task-Performed scales, job description profiles were derived by pay grade for the following pairs (A, B) of samples:

AD1269	ET1275	YN1386	TM368
AD500	ET500	YN500	
AD250	ET250	YN250	

Profiles were also derived for four pairs of service rating samples.

Stability indices (described below) were calculated to measure the similarity of profiles across the A and B samples. Profiles were compared (across the pair) at the same pay grade level (e.g., E-4 in both A and B samples) as well as at different pay grade levels (e.g., E-5 in one sample versus E-7 in the other paired sample). The similarity of principal

Table 2

Sample Sizes

N Samples Drawn	N and %	RATING			
		AD	ET	YN	TM
Population	N	14296	9050	9847	2513
Total Sample	N	2538	2546	2771	735
	%P	17.9	28.1	28.1	29.2
2	N	1269	1275	1386	368
	%A	50.0	50.0	50.0	50.0
	%P	8.8	14.1	14.1	14.6
1	N	2000	2000	2000	
	%A	78.8	78.5	72.2	
	%P	13.9	22.0	20.3	
2	N	1000	1000	1000	
	%A	39.4	39.2	36.1	
	%P	6.9	11.0	10.1	
2	N	500	500	500	
	%A	19.7	19.6	18.0	
	%P	3.4	5.5	5.0	
2	N	250	250	250	
	%A	9.8	9.8	9.0	
	%P	1.7	2.7	2.5	
		Service Rating[a]			
2	N	ADJ 976		ETR 366	
	%A	38.5		14.4	
	%P	13.6		8.1	
2	N	ADR 238		ETN 504	
	%A	9.3		9.0	
	%P	3.3		5.0	
		Holdout Group			
1	N	AD 540		YN 774	
	%A	21.3		27.9	
	%P	3.8		7.7	

Notes.

1. Deletion of cases due to missing data or samples with uneven numbers of personnel cause Ns to vary slightly for specific analyses and tables.

2. % A--Percent of total available sample (from actual administration).
   % P--Percent of population in rating.

[a]These service ratings have been or will be disestablished.
ADJ--Jet Engine Mechanic, ADR--Reciprocating Engine Mechanic, ETR--Radar, ETN--Communications.

interest was the comparison of profiles at the same pay grade level--the higher this similarity, the greater the stability of the average scale scores.

Scale Stability Indices

The following indices were calculated on the job description profiles across the A and B samples at each pay grade level.

1. To measure the stability of relative values (essentially, the rank order) of profile scores for tasks, the Product Moment correlation coefficient was calculated and labeled as:[2]

a. $\underline{r}_{MP}$, when calculated on the Percent of Members Performing (MP) profile.

b. $\underline{r}_{TSM}$, when calculated on the Average Percent Time-Spent by All Members (TSM) profile.

c. $\underline{r}_{TSMP}$, when calculated on the Average Percent Time-Spent by only those Members Performing (TSMP) profile.

2. To measure the stability of the absolute (i.e., actual percentage) scores for tasks, the difference in percentages of members performing tasks was calculated and labeled as:

a. Z-Difference, when indicating the proportion of inventory tasks not obtaining a significant percentage difference ($p > .05$, by Z-test, Walker & Lev, 1969, p. 188) (e.g., a proportion of .90 indicates that 9/10ths of the tasks in an inventory were not significantly different).

b. Percent Difference, when indicating the proportion of inventory tasks that did not differ by more than 05, 10, 15, and 20 percentage points (i.e., as with Z-Difference, a large proportion equals high stability).

Graphic Relationship Between Pay Grade Sample Size and Stability

Because the scores on the MP profile proved to be highly stable (see RESULTS, p. 8) and apparently more meaningful (see p. 10) than scores on the Average Percent Time Spent profiles, the plots to be described were constructed only for the MP profile data. Further, while the Z-Difference values (described above) were calculated, emphasizing their use might be misleading since lack of significance for percentage differences based on small ns could lead to an erroneous conclusion of adequate stability. Thus, only the values for the $\underline{r}_{MP}$ and the Percent Difference Stability indices were plotted against the pay grade sample sizes contained in the following pairs of samples (i.e., A and B samples) listed in Table 2: AD1269, ET1275, YN1386, and TM368. Only the $\underline{r}_{MP}$ and Percent

[2]The calculation treated tasks of job description profiles as cases, and task percentages as scores. Pairs of zero scores on corresponding tasks of two profiles were deleted from the calculation. With this correlational model, complete independence of scores did not exist; that is, the same individuals provided responses for calculation of a percentage (i.e., score) for more than one task. Cragun and McCormick (1967), however, report only minor inflation for correlation coefficients derived with this same model for the study of U.S. Air Force task analysis inventory reliability.

Difference values that were calculated for corresponding pay grades (e.g., E-3 for sample A compared to E-3 for sample B) were plotted. The plotted stability values (proportions of rs) can range from zero (no stability) to 1.0 (maximum stability).

A computerized, cubic-spline, curve-smoothing procedure was applied to the plotted data points. This procedure was deemed to be more appropriate than curve smoothing (or fitting) by means of linear regression because of the curvilinear (asymptotic) nature observed in the data. The spline curve procedure generates the smoothest possible curve that passes, on the average, within a specified distance of the data points (ISSC, 1973, pp. 11-7 to 11-9).

Since the relationship between the Percent Difference values and sample size of pay grade appeared to be curvilinear, the eta coefficient, as opposed to the linear correlation coefficient, was calculated between these two variables (see formulae in Dunnette, 1966, pp. 146-148).

Relationship Between Task-Performed and Relative Time-Spent Scales

Preliminary observation indicated little informational difference between the Percent of Members Performing (MP) profile (derived from the Task-Performed scores) and the Average Percent Time-Spent by All Members (TSM) profile (derived from the Relative Time-Spent scores). Thus, if the information obtained from the two scales is highly redundant, the time demands on the job incumbent could be reduced by administering a two-point Task-Performed scale. To confirm empirically this preliminary observation, correlations between these profiles were calculated (using the same model described in Footnote 2) within each of the eight pay grades, E-2 through E-9, using one of the AD1269 and one of the TM368 samples.

Procedures to Determine Cluster Solution Stability

Employing the CODAP (IBM 360 version) hierarchical cluster procedure (see Appendix A), 24 separate cluster analyses were performed on the following samples:

AD2000	ET2000	YN2000	TM735
AD1000 (A & B)	ET1000 (A & B)	YN1000 (A & B)	TM368 (A & B)
AD500 (A & B)	ET500 (A & B)	YN500 (A & B)	
AD250 (A & B)	ET250 (A & B)	YN250 (A & B)	

These analyses resulted in 24 hierarchical cluster solutions. Since 2000 is the maximum number of cases that can be cluster-analyzed by the IBM version, these sized samples (and the TM735 sample) are the "total samples" for this part of the method.

Selection of Clusters

Since a hierarchical cluster solution consists of a set of overlapping clusters (i.e., smaller clusters are contained in larger clusters), criteria to select the sets of nonoverlapping (mutually exclusive) clusters on which to evaluate stability had to be specified. These criteria were:

1. Cluster size--At least one percent of the sample and as large as possible while still meeting the following criteria.

2. Mutually exclusive cluster membership--No individual in more than one selected cluster.

3. Cluster homogeneity (by CODAP-generated homogeneity index, Overlap Between)--At least 35 percent. (A second CODAP-generated homogeneity index, Overlap Within, was not part of the selection criteria, since it is strongly influenced by the membership N of the cluster.)

Cluster Matching Procedure

Selected clusters were systematically matched across the A and B pairs of independent samples from which they were derived. The rationale and a detailed description of the matching procedure are provided in Appendix C. In general, the procedure matched the two clusters that were most similar to the same cluster derived from the rating total sample (i.e., from the AD2000, ET2000, YN2000, and TM735 samples in Table 2). Thus, any two matched clusters were counterparts of a single cluster from the total sample. The term "matched" refers only to clusters determined to be related across the independent A and B samples. The term "corresponding" associates any total sample cluster with its A and B counterparts.

Cluster Stability Indices

Job description profiles were calculated for each of the selected clusters. Comparisons between cluster profiles were made by using the three indices of profile similarily described below. The first two indices are essentially "cluster-to-cluster" profile comparisons. That is, the indices are calculated between two clusters on the same type of profile (i.e., MP, TSM, or TSMP profile). High profile similarity between corresponding clusters indicates high stability. By contrast, the third index compared the profile data of individuals from an independent, holdout sample to the profiles calculated for the selected clusters. This index was used in an assignment procedure to determine if the same individuals would be assigned to each of the clusters in a matched pair. The same individuals will be assigned to each of the clusters if the matched clusters are stable.

1. Product-moment correlation coefficient. This index was calculated on the three types of job description profiles (MP, TSM, TSMP), between the clusters matched across the A and B pairs of samples. Thus, each $\underline{r}_{AB}$ indicated the stability of one of the three types of job description profiles for a pair of matched clusters derived from the A and B samples of 1000, 500, 368, or 250. The index is labeled as either MP $\underline{r}_{AB}$, TSM $\underline{r}_{AB}$, or TSMP $\underline{r}_{AB}$, depending on the profile being compared. The average of obtained index values for the set of matched clusters derived from one pair of A and B samples was also calculated. (See footnote 2 for the correlational model applied.)

The correlation coefficient was also calculated between the MP profile of the total (T) sample clusters and the MP profile for the clusters matched across the A and B pair of samples. Thus, each $\underline{r}_{TA}$ and $\underline{r}_{TB}$ indicated the stability of the MP profile of a cluster from one of the 1000, 500, 368, and 250 paired samples when compared with the profile of a corresponding total sample cluster. The average of $\underline{r}_{TA}$ and $\underline{r}_{TB}$ values was also calculated for all clusters compared for each reduced sample.

2. Number of tasks performed. This tally was the number of tasks in the MP profile with a percentage value greater than 0 for one or both matched clusters being compared. A decrease in this tally, as sample size is reduced, would indicate a loss of task information (i.e., more tasks were obtaining zero scores for both matched clusters). The average of these tallies (labeled Av. N Tasks) was calculated for the set of matched clusters for each of the 1000, 500, 368, and 250 sample pairs.

3. Percent of Common Membership in Matched Clusters. This index was calculated on the MP and TSM profiles. The procedures for calculating this index are described in more detail in Appendix C. Comparing each individual's profile with each cluster profile, the individual was "assigned" to the cluster with the best fit--first to the cluster from the A sample, then to the best fit cluster from the B sample. Next, the individual's assignment to both of the matched clusters (across the A and B samples) was checked, and a Percentage of Common Membership was calculated on the common vs. total membership for the two matched clusters. (Because of the extensive calculations required to compare hundreds of individual profiles with each of several clusters, this part of the analysis was performed only on the A and B AD1000 and YN1000 samples.) The total or overall Percentage of Common Membership was also calculated for each set of AD and YN matched clusters (i.e., the percentage was calculated on the common vs. total membership that was summed over all matched clusters in each set).

Relationship Between Cluster Membership Size and Stability

While the above analyses determined the effect of the size of the total sample on deriving a set of stable clusters, this next analysis related the stability of single clusters to the number of members within each cluster. The value of the stability index, $\underline{r}_{AB}$, for the MP profile (see "1" above) was plotted against the average membership $\underline{N}$ for the two matched clusters (of the A and B samples on which the $\underline{r}_{AB}$ was calculated). These plots were constructed for matched clusters derived from the pairs of the AD1000, ET1000, YN1000, and TM368 samples. The curve-smoothing procedure (see page 5) was also applied to these data. It should be noted that the MP $\underline{r}_{AB}$ index, as well as the other correlational indices described above, measure the stability of the relative values of the percentages on cluster profiles.

RESULTS

Comparison Among Scales

Stability of Scales

As shown in Table 3, the stability of the Average Percent Time-Spent by All Members (TSM) profile and the Percent of Members Performing (MP) profile was found to be very high; and that of the Average Percent Time-Spent by (only) Members Performing (TSMP) profile, relatively low. For example, the mean correlation coefficients for pay grades E-2 through E-9 were mostly .90 or above--never below .80--for all ratings for both the TSM and MP profiles, while those for the TSMP profiles were .28, .43, .36, and .28 for the four ratings. Furthermore, for 12 of 32 comparisons (i.e., eight pay grades for four ratings) at the same pay grade level (e.g., E-3 for the A and B samples), the $\underline{r}_{TSMP}$ coefficient was not even significantly different from zero, indicating no similarity or stability between profiles.

Examination of the $\underline{r}_{TSMP}$ coefficients revealed that 22 of the 32 comparisons at the same pay grade level (i.e., for the E-2 through E-9 comparisons for the AD1269, ET1275, YN1386, and TM368 samples) yielded lower values than some different level pay grade comparisons (e.g., E-3 with E-5). On the other hand, $\underline{r}_{MP}$ and $\underline{r}_{TSM}$ values were generally much higher for the same level than for different level pay grades, and systematically decreased as pay grade disparity increased (see Appendix D--Table D-1 for intercorrelations for the AD1269 samples. Results for three other ratings are available on request from the Navy Personnel Research and Development Center, Code 310).

Table 3

Stability of Job Description Profiles

Pay Grade	Statistics[b]	Rating Sample[a] AD 1269 MP A	AD 1269 MP B	AD 1269 TSM A	AD 1269 TSM B	AD 1269 TSMP A	AD 1269 TSMP B	ET 1275 MP A	ET 1275 MP B	ET 1275 TSM A	ET 1275 TSM B	ET 1275 TSMP A	ET 1275 TSMP B	YN 1386 MP A	YN 1386 MP B	YN 1386 TSM A	YN 1386 TSM B	YN 1386 TSMP A	YN 1386 TSMP B	YN 368 MP A	YN 368 MP B	YN 368 TSM A	YN 368 TSM B	YN 368 TSMP A	YN 368 TSMP B
2	r	.95		.91		-.02[c]		.98		.84		.03[c]		.87		.78		.20[c]		.69[c]		.76		.26[c]	
	Av. %	6.1	9.9	0.2	0.3	2.3	2.8	7.8	11.6	0.2	0.3	0.9	1.5	6.7	9.4	0.2	0.2	1.8	1.7	9.5	19.2	0.3	0.6	1.1	1.9
	S.D.	10.2	12.1	0.5	0.5	3.6	2.7	14.2	16.4	0.4	0.5	1.4	1.8	9.8	11.2	0.4	0.4	1.9	1.2	15.0	19.3	0.7	1.0	1.6	1.7
	N:Tasks, Persons	325, 68						375, 25						449, 55						180, 8					
3	r	.98		.97		.12[c]		.97		.96		.31		.96		.94		.19		.88		.92		.18[c]	
	Av. %	8.6	9.0	0.2	0.3	2.5	2.4	10.3	11.7	0.2	0.2	1.1	1.3	9.0	8.1	0.2	0.2	1.8	1.9	12.6	13.9	0.3	0.3	1.6	1.8
	S.D.	12.1	12.2	0.4	0.4	2.4	1.9	16.4	16.2	0.3	0.3	0.8	0.8	11.4	9.9	0.3	0.3	1.6	1.0	14.6	17.0	0.5	0.5	1.2	1.3
	N:Tasks, Persons	388, 149						527, 79						523, 153						304, 29					
4	r	.99		.98		.09[c]		.99		.99		.50		.99		.98		.54		.96		.95		.31	
	Av. %	11.7	12.2	0.2	0.3	2.2	2.0	12.7	12.9	0.2	0.2	1.1	1.1	10.4	10.0	0.2	0.2	1.6	1.6	16.2	14.6	0.3	0.3	1.5	1.6
	S.D.	13.2	13.6	0.3	0.3	1.7	1.1	16.6	16.3	0.3	0.3	0.4	0.5	11.7	11.4	0.3	0.3	0.6	0.6	17.8	16.1	0.4	0.4	0.7	0.9
	N:Tasks, Persons	401, 283						596, 375						528, 427						332, 66					
5	r	.99		.98		.37		.99		.99		.60		.99		.98		.41		.98		.97		.38	
	Av. %	14.1	15.0	0.2	0.3	1.7	1.5	16.6	17.5	0.2	0.2	0.9	0.8	12.5	12.7	0.2	0.2	1.4	1.3	18.0	19.5	0.3	0.3	1.6	1.3
	S.D.	14.4	15.0	0.3	0.3	1.7	0.5	18.2	18.2	0.2	0.2	0.2	0.3	13.5	13.9	0.2	0.2	0.6	0.6	16.9	17.2	0.3	0.3	0.6	0.5
	N:Tasks, Persons	404, 337						596, 375						528, 360						337, 126					
6	r	.98		.94		.36		.99		.98		.55		.99		.97		.21		.96		.93		.49	
	Av. %	15.0	14.2	0.2	0.3	1.4	1.5	20.1	20.5	0.2	0.2	0.7	0.7	18.5	16.9	0.2	0.2	0.9	1.0	24.2	21.7	0.3	0.3	1.1	1.2
	S.D.	14.5	13.7	0.3	0.3	0.7	1.0	19.3	19.6	0.2	0.2	0.2	0.2	16.4	16.1	0.2	0.2	0.5	1.1	18.3	17.3	0.3	0.3	0.4	0.5
	N:Tasks, Persons	404, 281						596, 254						528, 243						336, 92					
7	r	.98		.97		.39		.97		.97		.31		.98		.98		.71		.93		.89		.32	
	Av. %	14.2	14.8	0.2	0.3	1.2	1.3	22.3	21.9	0.2	0.2	0.6	0.6	22.6	24.5	0.2	0.2	0.7	0.7	24.0	25.0	0.3	0.3	1.0	1.0
	S.D.	17.8	17.5	0.4	0.4	0.7	0.7	19.0	18.6	0.2	0.2	0.4	0.3	19.7	20.5	0.3	0.2	0.4	0.3	19.8	21.0	0.4	0.4	0.6	0.4
	N:Tasks, Persons	400, 108						589, 99						515, 133						323, 36					
8	r	.94		.92		.45		.91		.88		.51		.90		.88		.29[c]		.75		.86		.47[c]	
	Av. %	11.1	16.2	0.2	0.3	1.0	1.3	19.9	21.7	0.2	0.2	0.6	0.6	19.5	24.2	0.2	0.2	0.6	0.7	27.5	33.4	0.3	0.4	0.7	0.9
	S.D.	19.0	29.8	0.5	0.5	1.0	0.8	19.5	19.1	0.2	0.2	0.4	0.3	20.3	22.7	0.3	0.3	0.6	0.5	25.1	25.8	0.4	0.4	0.6	0.5
	N:Tasks, Persons	391, 11						574, 33						467, 27						273, 11					
9	r	.81		.59		.27[c]		.65		.81		.61		.74		.65		.32[c]		.25[c]		.33[c]		-.08[c]	
	Av. %	9.9	24.4	0.2	0.7	0.6	2.1	14.5	15.9	0.2	0.2	0.6	0.8	21.9	30.9	0.2	0.2	0.5	0.6	12.0	64.9	0.3	0.6	0.5	0.9
	S.D.	19.7	23.1	0.8	1.0	1.2	1.4	14.5	17.0	0.1	0.4	0.7	0.7	20.0	16.9	0.3	0.3	0.7	0.6	25.5	29.1	0.7	0.4	1.0	0.4
	N:Tasks, Persons	130, 14						468, 12						458, 11						158, 2					
	Mean r	.95		.91		.28		.92		.93		.41		.93		.90		.36		.80		.826		.28	

[a]Job description profile: MP--Percent of Members Performing, TSM--Average Percent of Time-Spent by All Members, TSMP--Average Percent of Time-Spent by Members Performing. A and B columns denote the paired samples.

[b]The model to calculate r treats profile tasks as cases and profile percentages as scores. Av. % is the average percent per task calculated from the A or B profile of percentages. S.D. is the standard deviation of the A or B profile percentages. N Tasks is the number of tasks or cases, excluding any task that scored zero for both A and B samples, on which the r was calculated. Both the N Persons and N Tasks remained the same for calculation of r for each profile for a rating pay grade.

[c]Correlation coefficient (r) is not significant ($p > .05$). Coefficients not footnoted are significant ($p \leq .05$). Since the model used to calculate r treats nonindependent profile tasks as cases, N Persons in each A and B pay grade (i.e., number of possible responses per task), not the N Tasks in the profile, was used to determine df as in Cragun and McCormick (1967). Use of N Persons, which was always smaller than N Tasks, will result in a more conservative test. If N Persons was not equivalent for the A and B pay grades, the larger N was used to determine df, and that N is displayed.

Similar correlational results were obtained for the four service ratings (i.e., for the A and B samples ADJ976, ADR238, ETR366, and ETN504 listed in Table 2). That is, very high $\underline{r}_{MP}$ and $\underline{r}_{TSM}$ values (e.g., for comparisons at the same pay grade level for ETR and ETN, respectively, mean $\underline{r}_{MP}$ = .89 and .94), and very low $\underline{r}_{TSMP}$ values (e.g., ETR and ETN mean $\underline{r}_{TSMP}$ = .27 and .22) were obtained. (Service rating results are available on request.)

Relationship Between Scales

Little informational difference (i.e., little independence) was found between the relative values of the MP and TSM profiles. As Table 4 shows, correlations between these profiles were in the mid .90s (except for pay grade E-9).

Table 4

Correlation Between Profiles of the Percent of Members Performing (MP) and the Average Percent Time-Spent by All Members (TSM)

Rating Sample		Pay Grade E-2	E-3	E-4	E-5	E-6	E-7	E-8	E-9
AD1269	$\underline{r}$	.94	.96	.97	.97	.93	.96	.96	.72
	$\underline{N}$[a]	67	149	282	337	281	108	31	14
TM368	$\underline{r}$	.92	.94	.96	.96	.94	.90	.92	.83
	$\underline{N}$[a]	08	29	66	125	92	36	10	02

[a] $\underline{N}$ is the number of persons within pay grade sample.

Meaningfulness of Average Scale Scores

The magnitudes of the TSM percentages (i.e., average scores on the Relative Time-Spent Percentage Scale) for the pay grades of all ratings analyzed were generally found to be substantially below 1 percent and very often below .1 percent. This finding suggests that all members in the pay grade spend, on the average, much less than 1 percent of their time performing any single task.

Appendix E (pages E-1 through E-8) contains the average scale scores (i.e., percentages) for portions of the three job description profiles for YN pay grade E-5 and for TM pay grade E-7. The displayed scores were ordered by the TSM scores, from the highest value in the entire profile to the lowest (although the lowest value is not shown due to space limitation). The percent Time-Spent value is above 1 percent for only 18 of 337 tasks in the TM task inventory (page E-1), and less than .1 percent for more than 100 of the 337 TM inventory tasks. Very small values (i.e., about 1 percent) are also typically obtained for the TSMP profile. Tasks performed for only minute fractions of the job incumbent's time tend to yield information of little use for decisions regarding the structuring or staffing of billets. On the other hand, values for the MP profile (see pages

E-1 through E-8) appear meaningful and useful. For example, the values displayed for TM E-7 (Table E-1) range from about 2 percent to about 82 percent with substantial percentages of personnel performing many of the inventory tasks.

Stability for Varying Sample Sizes

The expected relationship was found between all of the stability indices and pay grade sample size (see Appendix F, Tables F-1 through F-4). As pay grade sample size increased, the stability increased (e.g., as sample size for the YN pay grades increases from 10 to 340, the obtained $r_{\overline{MP}}$ value increases from .74 to .99--see Table F-4).

Figures 1 and 2 display the plots between stability and sample size. (The derivation of the plot axes and the curve smoothing procedure are described on pages 5 and 6). Curve 1 in Figure 1, which plots sample size against the 10 Percent Difference index, indicates that extremely high stability was attained when sample size within pay grade reached about 100; and high stability, when the size reached about 30. Curve 2, which plots the more rigorous 05 Percent Difference values (see page 5) indicates that very high stability was attained when sample size reached about 240; and moderate stability, when the size reached about 100. Generally, the improvement in stability begins to drop rapidly for increases in pay grade size above 40 in Curve 1, and for increases above 140 for Curve 2.

The curve in Figure 2, which plots the $r_{\overline{MP}}$ values, is highly similar to Curve 1 in Figure 1. Both display high stability when sample size exceeds about 30 and extremely high stability for samples above 100. Also, both curves are clearly asymptotic and show minimum improvement in stability for increases above 40.

If we compare the curves in Figure 1 for a sample of 100, we find that an increase of 50 percent, to 150, would raise stability in Curve 2, which plots by the more rigorous criterion, from .75 to .83, but that it would produce hardly any gain by Curve 1--already at .97. If we compare Figures 1 and 2 for a sample of 80, we find that Curve 2 in Figure 1 indicates a stability index of only .70, but the curve in Figure 2, an index of .95. Table 5, which presents corresponding points on all of the curves for selected sample sizes, indicates that sampling above size 240 would produce very little gain, even in terms of the most rigorous stability criterion. Further, if only the rank order of percentages of members performing tasks is required, a sample size of 100 or even 40 would be acceptable ($r_{\overline{MP}}$ = .97 or .90).

The eta coefficients (η), calculated between sample size and each of the stability indices of Figure 1 (see Dunnette, 1966) were quite high--η = .76 for Curve 1 and .88 for Curve 2 ($p < .01$, $df = 5, 26$)--indicating a significant consistency for pay grades of different occupational areas.[3]

Stability of Clusters

As shown in Table 6, the number of clusters selected from each of the 24 obtained solutions ranged from 10 to 16 for the largest samples, and from 13 to 17 clusters in the smallest samples. Also, for all ratings except YN, the percentage of personnel from each

[3]For the calculation of both coefficients, six intervals were constructed for the independent variable (i.e., sample size), thus assuring at least three observations per interval (see Lewis, 1960, pp. 120-122). For significance test of eta, see Hays, 1963, Formula 16.6.4.

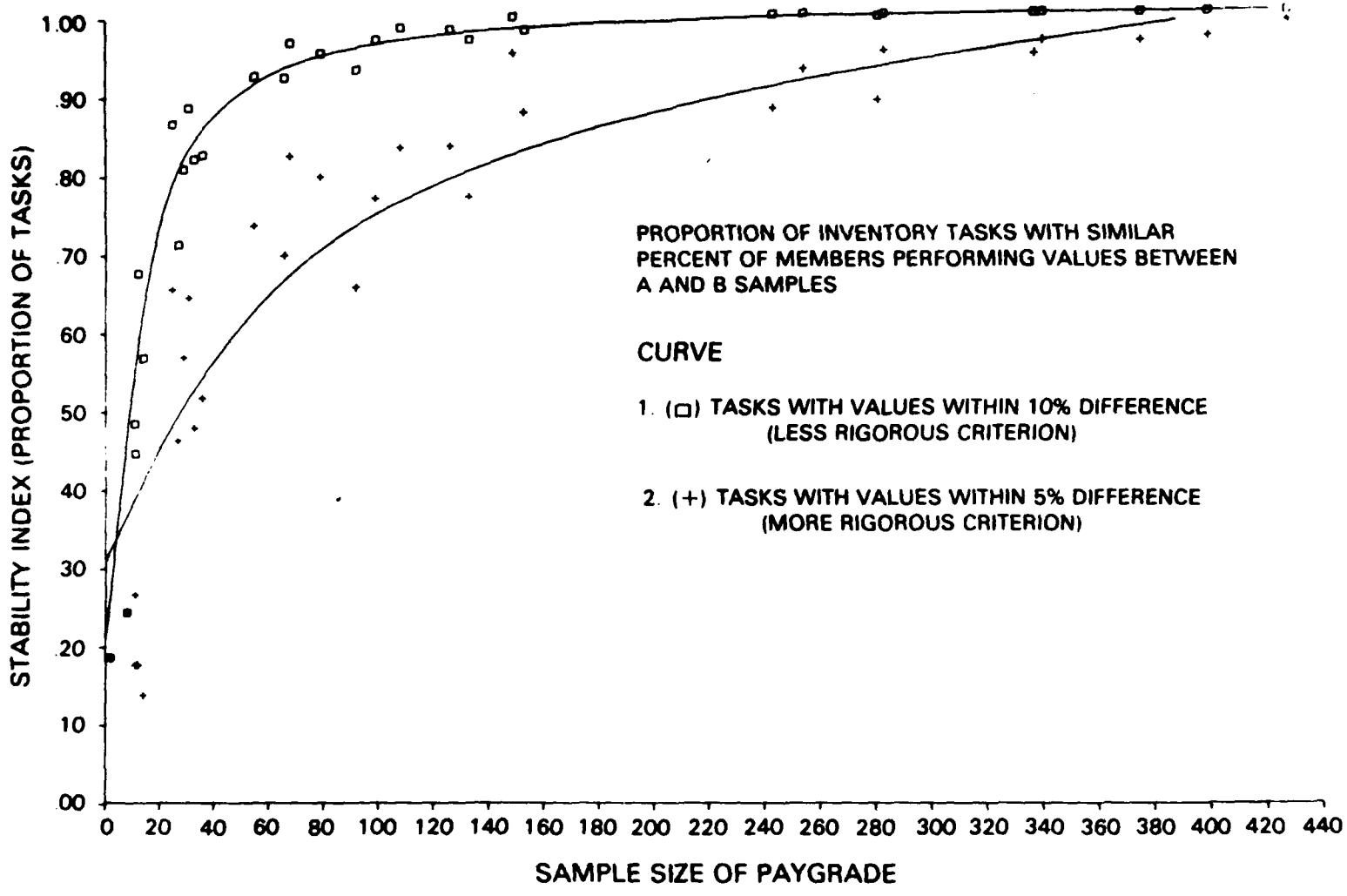

Figure 1. Stability of absolute percentages of the Percent of Members Performing (MP) profile.

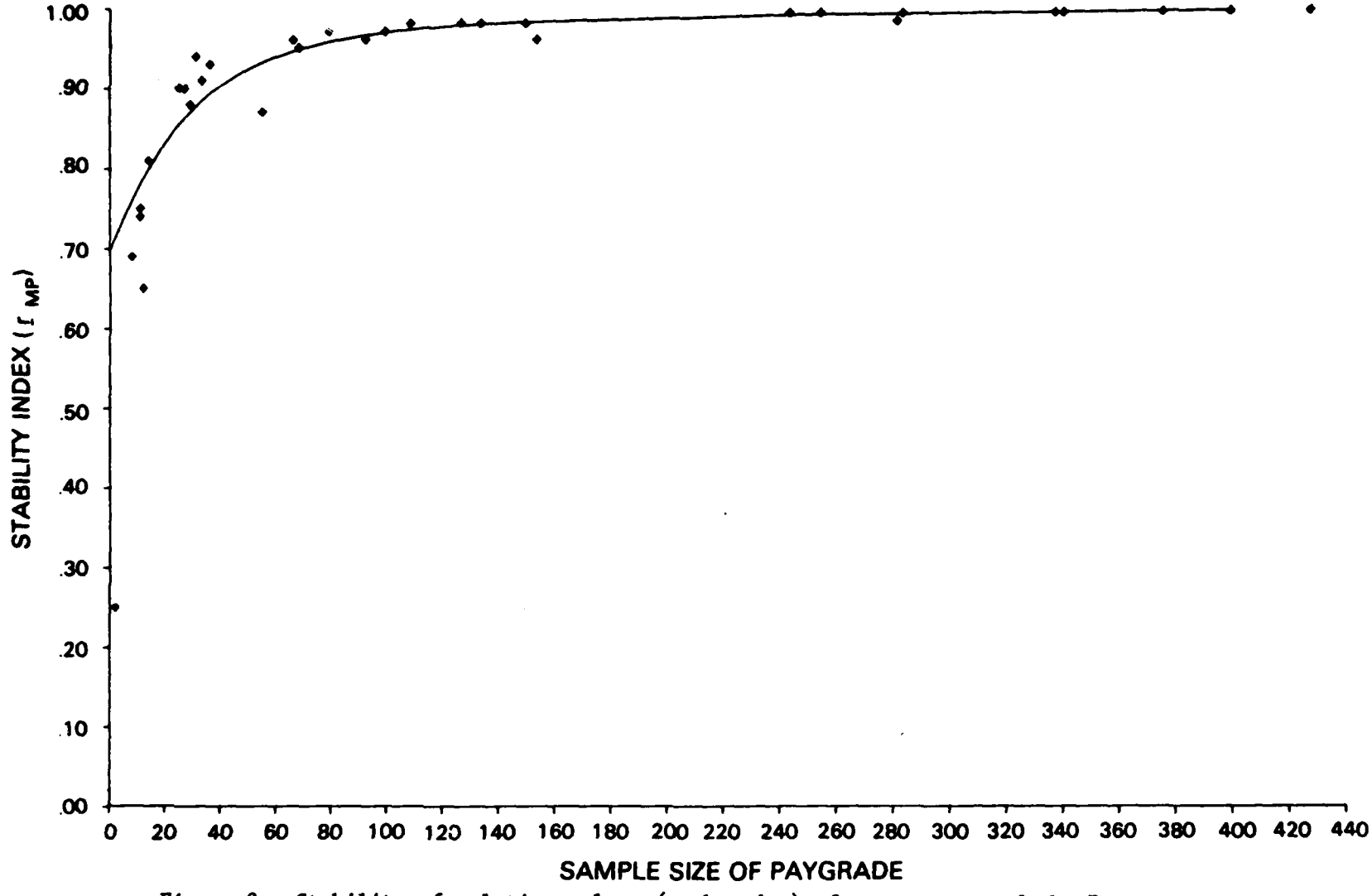

Figure 2. Stability of relative values (rank order) of percentages of the Percent of Members Performing (MP) profile.

sample who were included within selected clusters by rating is similar (e.g., for the AD rating, the percentages ranged from 66.6 for the sample of 1000, to 74.4 for the sample of 250, compared with 38.2 ($\underline{N}$ = 1000) to 55.8 ($\underline{N}$ = 250) for YN. Except for TM, very similar numbers of clusters were selected for solutions based on the total sample (i.e., the AD2000, ET2000, and YN2000 samples) compared with the numbers of clusters selected from the size 1000 samples.

Table 5

Comparison of Three Stability Indices for Selected Sample Sizes

	Stability Index		
	Proportions of Inventory Tasks with Percent of Members Performing Within:		Rank Order of Tasks by Values of Percent of Members Performing
Sample Size Within Pay Grade	5% Diff. (more rigorous criterion)	10% Diff. (less rigorous criterion)	$\underline{r}_{MP}$
40	.58	.87	.90
100	.75	.97	.97
240	.91	1.0	.99
340	.96	1.0	.99
440	.99	1.0	.99

Table 6

Number of Clusters Selected from Total Cluster Samples and Pairs of Reduced Samples

N[a]	Rating Cluster Solution							
	AD		ET		YN		TM	
%	A	B	A	B	A	B	A	B
N of Selected Clusters	16		13		10		12	
Sample N	2000		1996		1998		735	
% Sample N in Clusters	68.4		73.8		39.0		73.2	
N of Selected Clusters	17	15	16	13	9	11	11	17
Sample N	999	1000	1000	996	999	998	368	367
% Sample N in Clusters	72.9	66.6	77.1	74.6	38.2	43.8	73.6	78.7
N of Selected Clusters	20	18	14	18	8	13		
Sample N	500	499	500	499	499	500		
% Sample N in Clusters	74.2	69.3	74.6	80.4	42.3	42.8		
N of Selected Clusters	17	16	13	14	16	16		
Sample N	250	250	250	250	250	249		
% Sample N in Clusters	71.6	74.4	79.2	82.4	52.0	55.8		

[a]N of Selected Clusters refers to only those clusters selected by criteria on page 6.

The matching procedure (described in Appendix C) produced a set of matched clusters for each A and B pair of independent samples of 1000, 500, and 250, as well as for the pair of TM368 samples.

Cluster Stability by Type of Scale

When comparing all three job description profiles across AD1000 matched clusters, stability was found to be very high for the MP and TSM profiles (see Table 7), but very low for the TSMP profile. As Table 7 shows, the mean values for the MP $\underline{r}_{AB}$, TSM $\underline{r}_{AB}$, and TSMP $\underline{r}_{AB}$ coefficients were .89, .90, and .17. These results, across clusters, are highly similar to the results across pay grades already reported (on page 8). Because of these results, and the finding that MP and TSM profiles were highly correlated (see Table 4), it was decided to evaluate cluster stability only on the basis of the MP profile.

Cluster Stability by Sample Size

Correlational Results. The high MP $\underline{r}_{AB}$ average values obtained for samples of 1000 (see Table 8 and the analytical design described in Appendix C) indicate the following relationships: (1) high stability for clusters derived from independent samples of 1000, (2) high stability for clusters from total samples of 2000, since highly similar clusters (which were counterparts of total sample clusters) were found in both half samples of 1000, and

Table 7

Similarity of Job Description Profiles Across
Matched Clusters for the AD1000 Paired Samples

Cluster ID# and membership	Matched Clusters From Sample A	B	Stability Index r_{-AB} MP	TSM	TSMP
#	1	4	.98	.98	.08
N	103	67			
#	5	2	.92	.94	.15
N	34	39			
#	2	5	.80	.81	.21
N	92	32			
#	7	6	.73	.70	.04
N	44	29			
#	3	1	.96	.96	.06
N	71	97			
#	6	3	.96	.96	.26
N	45	51			
#	8	8	.93	.94	.22
N	20	69			
#	10	9	.99	.99	.20
N	109	115			
#	13	11	.93	.95	.15
N	21	20			
#	12	13	.94	.92	.20
N	24	36			
#	14	7	.59	.64	.06
N	28	12			
#	16	14	.82	.85	.07
N	22	11			
#	15	12	.93	.94	.41
N	31	47			
#	17	15	.95	.96	.32
N	39	29			
		Mean =	.89	.90	.17

Note. Data presented are for those matched clusters selected only by criterion on p. 6.

Table 8

Average Stability Values of Members Performing (MP) Profile for Matched Clusters from Reduced Samples

Rating	Index[a]	Sample Size			
		1000	500	368	250
AD	Av. $\underline{r}_{AB}$ and Range (for Matched Clusters)	.89 .59-.98	.82 .56-.98		.73 .37-.94
	Av. $\underline{N}$ Tasks	281	240		240
	Av. $\underline{r}_{AB}$ (All Clusters)	.25	.16		.12
	Av. $\underline{r}_{TA}$ and $\underline{r}_{TB}$	.95 .93	.93 .89		.88 .88
	N Cluster Pairs (1st Search)	14	15		12
	N Cluster Pairs (2nd Search)	2	1		4
ET	Av. $\underline{r}_{AB}$ and Range (for Matched Clusters)	.87 .69-.98	.82 .62-.96		.78 .48-.96
	Av. $\underline{N}$ Tasks	415	428		395
	Av. $\underline{r}_{AB}$ (All Clusters)	.48	.39		.32
	Av. $\underline{r}_{TA}$ and $\underline{r}_{TB}$	.90 .94	.86 .91		.89 .87
	N Cluster Pairs (1st Search)	11 .94	10		10
	N Cluster Pairs (2nd Search)	2	3		3
YN	Av. $\underline{r}_{AB}$ and Range (for Matched Clusters)	.89 .75-.97	.80 .47-.96		.62 .30-.96
	Av. $\underline{N}$ Tasks	375	338		291
	Av. $\underline{r}_{AB}$ (All Clusters)	.50	.40		.22
	Av. $\underline{r}_{TA}$ and $\underline{r}_{TB}$	.93 .94	.84 .89		.78 .81
	N Cluster Pairs (1st Search)	8	7		9
	N Cluster Pairs (2nd Search)	2	3		1
TM	Av. $\underline{r}_{AB}$ and Range (for Matched Clusters)			.80 .50-.97	
	Av. $\underline{N}$ Tasks			224	
	Av. $\underline{r}_{AB}$ (All Clusters)			.24	
	Av. $\underline{r}_{TA}$ and $\underline{r}_{TB}$			.92 .90	
	N Cluster Pairs (1st Search)			10	
	N Cluster Pairs (2nd Search)			2	

Notes.

1. To evaluate the relative magnitude of the Av. $\underline{r}_{AB}$ for Matched Clusters, the $\underline{r}_{AB}$ index was also calculated between each selected cluster of sample A with each selected cluster of sample B. The average of these values is displayed as Av. $\underline{r}_{AB}$ (All Clusters).

2. All displayed indices were calculated only for clusters selected by 1st search criteria (see page 6).

3. $\underline{N}$ of Cluster Pairs is the number of pairs of matched clusters selected by the 1st and 2nd search criteria (see 2nd search criteria on page C-2 and C-3).

[a]For calculation of Av. $\underline{r}_{AB}$, Av. $\underline{N}$ Tasks, and Av. $\underline{r}_{TB}$, see page 7.

(3) minimal differences between clusters from samples of 1000 and total sample clusters, since the 1000 size clusters were counterparts of the total sample clusters.

By the MP $\underline{r}_{AB}$ index, cluster stability declined as sample size was reduced, and dropped noticeably from sample sizes of 1000 to 250 (see Av. $\underline{r}_{AB}$ for Matched Clusters in Table 8). For example, the average MP $\underline{r}_{AB}$ index for the YN1000, 500, and 250 samples dropped from .89 to .80 to .62. The difference in MP $\underline{r}_{AB}$ average values between clusters from samples 1000 and 250 (ranging from about 9 to 27 correlation points) is substantial, considering that the smaller samples are also contained in the larger samples.

Similar trends may be observed for the MP $\underline{r}_{TA}$ and MP $\underline{r}_{TB}$ indices (see Av. $\underline{r}_{TA}$ and $\underline{r}_{TB}$ in Table 8). For example, the Av. $\underline{r}_{TA}$ values for the AD1000, 500, and 250 samples decreases from .95 to .93 to .88. The dependence between each reduced sample (A or B) and the total sample, however, appears to maintain these values higher than average MP $\underline{r}_{AB}$ values. (The MP $\underline{r}_{AB}$, $\underline{r}_{TA}$, and $\underline{r}_{TB}$ values for each pair of matched clusters derived from samples of 1000 are displayed in Appendix G, Tables G-1 through G-3).

Number of Tasks Performed. A substantial loss of task-performed information (i.e., a drop in the number of tasks performed) occurred for matched clusters from samples of 250, compared with samples of 1000. For example, the number of tasks performed (see the index, Av. $\underline{N}$ Tasks, in Table 8) for the AD1000 and AD250 samples dropped from 281 to 240, and for the YN1000 and 250 samples, from 375 to 291.

Percent of Common Membership. With some exceptions, the clusters evaluated by this index were found to be moderately to highly stable, thus supporting further the stability demonstrated by the correlation indices above. Tables G-1 and G-2 display values for the Percent of Common Membership calculated on the MP and TSM profiles for the AD1000 and YN1000 samples. For the AD matched clusters, the total index value calculated on the MP profile was 75.7 percent, and on the TSM profile, 81.1 percent (see Table G-1). Some of the values are low, however, especially for the YN samples (see Table G-2). The sizes of these percentages appear to have been lowered due to error of individual data (as distinguished from average profile data in the clusters) and due to the dependence among matched clusters within each sample (see Appendix C, page C-4 for further explanation). For the correlation indices, no corresponding decrease occurred because, for those indices, average profile data were used, and each pair of matched clusters was analyzed separately. It should also be noted that the values of the Percent of Common Membership for the MP and TSM profiles were highly similar (see Tables G-1 and G-2).

Cluster Stability by Membership Size

Figure 3 demonstrates a substantial drop in stability for the MP $\underline{r}_{AB}$ index when cluster membership (the number of incumbents within a cluster) was less than about 20.[4]

[4]Carpenter (1974) reported high stability for Task-Performed Data for clusters with membership greater than 10. The coefficients were calculated between overlapping clusters (i.e., stability was determined by comparing smaller clusters to larger clusters that contained the smaller clusters). Thus, the values would be overestimates.

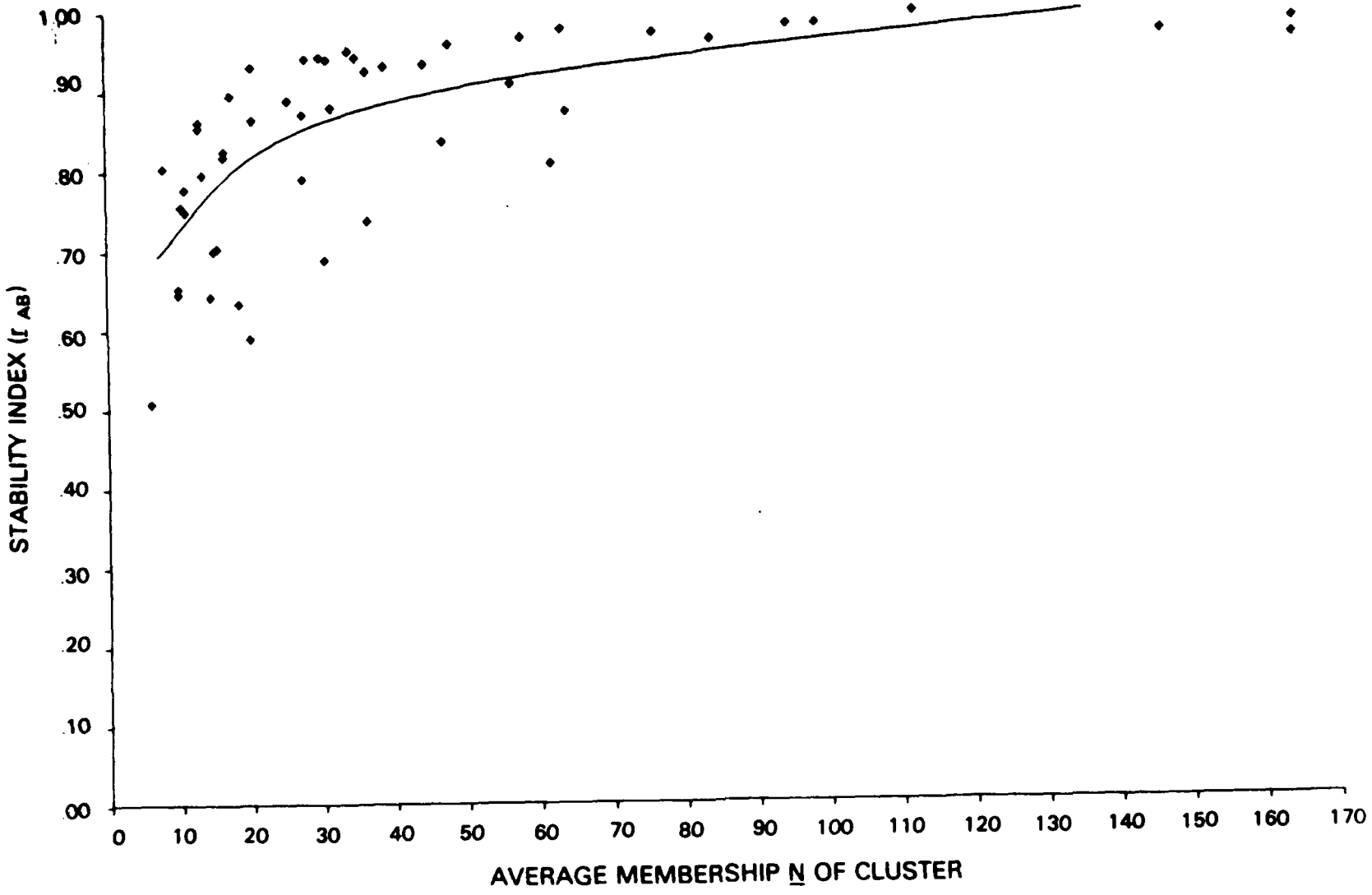

Figure 3. Stability of clusters by membership size.

DISCUSSION

Issues Pertaining to Properties of Inventory Scales

Effect of Zero Scores on Relative Time-Spent Scale

High stability was generally demonstrated for the TSM (Average Percent Time-Spent by all Members) profile, and low stability for the TSMP profile (Average Percent Time-Spent by only Members Performing) (see Table 3). While both profiles were calculated from responses to the Relative Time-Spent Scale, only the calculation of the Average Percent (i.e., Average Relative Time) scores for the TSM profile included zero scores for those incumbents in the sample who did not perform a task. The inclusion of zeros results in a substantial drop in the standard deviation between task scores (as observed in the difference between the TSMP and TSM standard deviation values in Table 3), and an apparent tendency for all TSM profiles (i.e., score distributions) to be positively skewed. A consistent shape in score distributions is reflected in the high correlation coefficients obtained between TSM profiles.

Validity of Scale Responses

It is noted parenthetically that the present study did not include a validation of either of the two scales (Task-Performed or Relative Time-Spent scales) on any external criteria (e.g., Subject Matter Expert judgments). Conclusions of other studies regarding the validity of the Relative Time-Spent scale responses have not been consistent (Hartley, Brecht, Pagery, Weeks, Chapanis, & Hoecker, 1977, vs. Carpenter, Giorgia, & McFarland, 1975; McCormick, 1976). Using instructors' daily recordings of the time spent on tasks as the criterion, Carpenter et al. (1975) reported findings that indicate that responses by U.S. Air Force trainees on the Relative Time-Spent scale were highly valid, regardless of the number of scale steps (e.g., 5 vs. 9 steps). As evidence, they reported that the difference between the Relative Time-Spent profile for trainees and instructor estimates, when converted to percentages, averaged about 1 percentage point on each task. There is a serious limitation to that kind of validation study, however, when comparing the CODAP-generated TSMP profile to a criterion that also consists of percentage of time spent. That is, if the number of tasks responded to on both profiles exceeds 100, then it is likely that most percentages being compared will be very small, often about 1 percent or less. Furthermore, such small percentages will result for any profile, regardless of the set of profile tasks. In the Carpenter et al. study, since the subjects were in a basic training program, it would be highly likely that both trainee and instructor would respond to most of the 130 training tasks, thereby increasing the likelihood that most Time-Spent percentages being compared would be very small, often below 1 percent. Thus, an error (or percent difference) averaging about 1 percent per task between the two profiles could be a relatively large error that might yield very low correlation values, if the relative order of the Time-Spent on tasks was analyzed (as was performed in the present study).

Hartley et al. (1977) compared job incumbent estimates of time spent on 23 work activities with on-site, recorded observations of the actual Time-Spent. They found an Average Time-Spent difference of about 24 percent and concluded that the accuracy of incumbent estimates is "suggestive at best," and that on-site observation may be more appropriate. (The small sample of 12 office workers, however, raises a question as to the stability of the average error obtained.)

It is noted that the Time-Spent values in the Hartley et al. study were based on worker's estimates of absolute time spent (hours or minutes, or percentages of a specific time period), which were then converted to relative time for the total observation period.

By contrast, Carpenter et al. reported that absolute Time-Spent values converted to percentages (by a slightly different procedure from Hartley et al.) were as accurate (by the instructor criterion) as the other Relative Time-Spent Percentage estimates. The validity of Relative Time-Spent estimates by incumbents appears to be questionable. Hartley et al., however, did report that incumbents can accurately rank-order tasks in terms of time spent. Also, they demonstrated that incumbents were very accurate in identifying the tasks that they performed, thus providing valid, task-performed data.

Minimal Information Gain from Relative Time-Spent Responses

It is reasonable to expect a finding of high similarity in the rank-order of tasks for TSM and MP profiles (results in Tables 3 and 7). (A similar finding is reported in Carpenter, 1974.) As the percent of members performing a task increases, the value of the average percent of time spent by all members on that task will be based on less zero scores, and thus also increase. These results indicate that the use of either profile in correlational-(or order)-type analyses will yield very similar results.

Disadvantages of the Relative Time-Spent Responses

For all ratings analyzed, extremely small values were obtained for the TSM profile scores--often less than one-half of a percent (see examples in Appendix E). This result makes meaningful interpretation of Relative Time-Spent per task data difficult. In informal discussions, Navy managers who use task information reported little use of the Relative Time-Spent scores.

Cragun and McCormick (1967) reported two other disadvantages of a Time-Spent scale. First, military officer job incumbents evaluated a Time-Spent scale less favorably than other standard response scales (e.g., importance-to-job scale). Second, Cragun and McCormick estimated that the job incumbents were able to mark only three or four tasks per minute on the Time-Spent scale. Using a three per minute estimate, it would take enlisted personnel approximately 2.5 hours to mark only 450 tasks out of the 800 to 1000 items in a standard inventory. (Cragun & McCormick also reported a test-retest correlation of about .60 for responses to a 9-point Time-Spent scale.)

. Substantial savings in inventory administration time, with little or no loss of useful information, would be realized if personnel samples marked only a Task-Performed scale and not also the Relative Time-Spent scale. Further, Task-Performed responses could routinely be derived from marks vs. no marks on another scale that is already a standard part of NOTAP inventories, the Involvement scale. (This scale is a 4-point scale indicating the type of job involvement--supervising, doing, supervising and doing, or assisting--with each task.)

Use of Alternative Scales to Derive Clusters

While the CODAP cluster analysis procedure operated on individual Relative Time-Spent scores, results (in Table 7) indicate that it produced clusters that are stable by the MP profile (derived from Task-Performed scores), and the closely related TSM profile, but not by the TSMP profile. This result suggests that the procedure may be essentially driven by Task-Performed data, not by the Relative Time-Spent data. Indeed, as illustrated in Appendix A, the Overlap Between values, which are the similarity index values for the clustering procedure, are more closely related to the TSM than to the TSMP profile. The data have clearly demonstrated the close relationship between the TSM profile and the Task-Performed responses (i.e., the Percent of Members Performing profile). CODAP options include a capability for clustering on Task-Performed responses,

thereby obviating reliance on Relative Time-Spent scores. (Another on-going study is comparing cluster solutions based on Task-Performed vs. Relative Time-Spent scores. The obtained similar values of the Percent of Common Membership index calculated on the MP profile (i.e., Task-Performed scores) and the TSM profile (i.e., Relative Time-Spent scores) as reported on page 18, suggest that little difference between such solutions will be found.)

In addition, continuous scale information for tasks performed by each incumbent could be derived more economically and perhaps more reliably by small samples of subject matter experts. These data could then be cluster analyzed by the CODAP system (see procedure in Pass and Robertson, 1979).

Alternative Cluster Selection Criteria

Although other clustering procedures rely on external judgments regarding additional data (e.g., job title, specialty code, type unit, pay grade), the objective method of selecting clusters in the present study did not. One criterion that was employed--using a minimum of 35 on the Overlap Between index (Archer, 1966)--appears to be useful for selecting stable clusters.

Utility of Findings

Cost-Effective Sampling for Inventory Administration

The empirically developed relationships (displayed in Figures 1 and 2) demonstrate that there are sample size ranges beyond which stability does not appreciably increase (i.e., the displayed curves are sharply asymptotic). This result strongly supports a justification to establish upper limits for sample size when collecting Task-Performed data (i.e., data to calculate the MP profile). It should be emphasized that, in general, sample size requirements for collecting dichotomous type scale data will be more than adequate for collecting continuous type (e.g., five point) scale data (Bemis, 1978).

For purposes such as identifying the inventory tasks that are performed by the most personnel, stable estimates of only the relative value or rank order (as displayed in Figure 2) of percentages of incumbents performing inventory tasks would be adequate. If stable estimates of the actual percentage of personnel performing tasks are required, the relationships displayed in Figure 1 can be applied to determine an adequate sample size. Further, the curves in Figures 1 and 2 can be used interactively to satisfy stability requirements for both types of estimates discussed above. Thus, management could specify minimum levels of stability both for the relative order of the percentages of MP tasks and for the absolute percentage of members performing each task.[5]

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[5]Farrell, Stone, and Yoder (1976) recommend a single sample size of about 400 personnel to be sampled from each Marine Corps Occupational Field. Based on informal discussions with U.S. Air Force investigators, it appears that determination of minimal sample sizes for inventory administration has not been performed. Christal (1974b) suggests sampling as many incumbents in the population as possible to assume an adequate sample size for deriving stable clusters and for analyzing all conceivable subgroups in the population.

For an application of Figures 1 and 2 to the ET rating (see Table B-1), sample sizes could be determined as follows: 100 from E-2, 240 each from E-3 through E-6, 200 from E-7, 100 from E-8, and 40 from E-9. This revised total sample of 1389 reflects a 45 percent reduction compared with the operational sample of 2546 for which data were actually collected. Further, these revised sample sizes would improve stability within those pay grades where such improvement is most needed. Similarly, substantial reductions in total sample size (i.e., a reduction of about 1000), while increasing overall stability, could be achieved for AD and YN ratings. For TM (see Table B-1), however, a reasonable application of the data in Figure 1 would indicate a requirement to increase sample size for certain pay grades as follows: 100 for E-2 and E-3 combined, 240 for E-4, 30 for E-8, and 11 for E-9 (see Table B-1 for remaining pay grade sample sizes). These pay grade increases would result in a relatively small increase of 151 personnel for the total sample (i.e., operational total of 735, compared with the revised total of 886). For each of the larger rating populations samples (i.e., populations with over 7000 personnel), records indicate sampling about 1000 more personnel than required. Thus, for the 15 larger ratings, a reduction of 15,000 personnel for inventory administration could be realized. Using 3.5 hours as an estimate of time to administer the inventory, 52,500 work hours (i.e., 15,000 x 3.5 = 52,500) could be saved each time these ratings were sampled. Alternatively, additional required information could be collected from the smaller samples while still decreasing somewhat the total work hours lost to the operational units.

The utility of these findings relies on the representativeness of the Navy units sampled (e.g., see Table B-2 for AD and ET ratings). It is reasonable to expect the findings to apply to occupations judged to be as homogeneous as (or more homogeneous than) pay grades within a rating. Although the study demonstrates sample size requirements for occupational specialties defined as Navy ratings, the methods are deemed to be similarly applicable to other levels of occupational description (e.g., a Navy Enlisted Classification Code (NEC) or a Military Occupational Specialty (MOS) of the other services).

An extension of the methods developed could be directed towards the question of when it is necessary to administer a subsequent inventory to the same rating (the present Navy cycle is about 4 years). Very small subsamples could be evaluated to detect changes over time in tasks performed, until some critical point is reached for which a full sample size is required. This extended application has implications for important decisions regarding when to revise occupational standards or training curricula.

Reduced Computer Processing Costs

The study demonstrated that appreciable drops in the stability of cluster solutions did not occur until the total sample (i.e., the sample that included personnel from pay grades E-2 through E-9) was reduced to 250 (see Table 8)--substantially below the total 2000 typically processed by the IBM 360 CODAP procedure. Thus, if total sample size was reduced to 1000 with the above procedures, highly stable clusters could still be derived. Further, since computer processing time for the cluster analysis procedure is an exponential function of sample size, and since the processing of about 2000 cases can exceed 7 hours of central processing unit (CPU) time on an IBM 360/67 computer and 3 hours on a UNIVAC 1108, reducing the sample by one-half will substantially reduce computer time and costs.

These findings apply only to clusters derived from heterogeneous samples of individual responses (as distinguished from average response data) on about 400-600 tasks.

CONCLUSIONS

1. No practical gain in stable, meaningful task information is achieved from enlisted job incumbent responses on the Relative Time-Spent scale, compared with the Task-Performed scale. More informative, and more efficiently collected estimates of the time spent per task could probably be based on incumbents' ranking of the most time-consuming tasks.

2. Task-Performed data; that is, percentages of personnel performing tasks, are highly stable for samples substantially smaller than samples previously collected.

3. Substantial data acquisition and processing costs can be saved by using the empirically-developed relationships to determine minimal sample sizes that optimize stability.

RECOMMENDATIONS

It is recommended that:

1. The Relative Time-Spent scale be deleted from future task inventories to reduce substantially administration time.

2. Alternative methods of estimating time spent performing tasks, including ranking the most time-consuming tasks, be used on a trial basis in task inventory surveys.

3. Responses to a currently administered inventory scale (see page 21) be used to calculate the percentage of incumbents performing tasks.

4. The study's empirically-developed guidelines be used as an aid to determine minimal sample sizes required for stable job analysis information.

REFERENCES

**Aleamoni, L. M. Effects of size of sample on eigenvalues, observed commonalities, and factor loadings. Journal of Applied Psychology, 1973, 58(2), 266-269.

Archer, W. B. Computation of group job descriptions from occupational survey data (Tech. Rep. PRL-TR-66-12). San Antonio, TX: Personnel Research Laboratory, December 1966.

**Armstrong, J. S., & Soelberg, P. On the interpretation of factor scores. Psychological Bulletin, 1968, 70(5), 361-364.

Bemis, J. C. Expanding the use of efficient sampling techniques. Defense Management Journal, 1978, 14(5), 20-22.

Carpenter, J. B. Sensitivity of group job descriptions to possible inaccuracies in individual job descriptions (Tech. Rep. AFHRL-TR-74-6). San Antonio, TX: Air Force Human Resources Laboratory, March 1974.

Carpenter, J. B., Giorgia, M. J., & McFarland, B. P. Comparative analysis of the relative validity for subjective time rating scales (Tech. Rep. AFHRL-TR-75-63). San Antonio, TX: Air Force Human Resources Laboratory, December 1975.

Christal, R. E. The United States Air Force occupational research project (Tech. Rep. AFHRL-TR-73-75). San Antonio, TX: Air Force Human Resources Laboratory, January 1974a.

Christal, R. E. The United States Air Force occupational research project. In E. I. Jones (Director), Occupational research and the Navy--Prospectus 1980. Symposium presented at the Navy Personnel Research and Development Center, San Diego, 1974b.

*Christal, R. E., & Ward, J. H., Jr. The maxof clustering model. In Lorr, M., & Lyerly, S. B. (Principal Investigators), Conference on cluster analysis of multivariate data (Final Rep.). Washington, DC: Office of Naval Research (Contract No. N00014-67-C-0175), Catholic University of America, June 1967.

Cochran, W. G. Sampling techniques. New York: John Wiley and Sons, Inc., 1953.

Cragun, J. R., & McCormick, E. J. Job inventory information: Task and scale reliabilities and scale interrelationships (Tech. Rep. PRL-TR-67-15). San Antonio, TX: Personnel Research Laboratory, November 1967.

*Cronbach, L. J., & Gleser, G. C. Assessing similarity between profiles. Psychological Bulletin, 1953, 50(6), 456-473.

Dunnette, M. D. Personnel selection and placement. Belmont, CA: Wadsworth Publishing Company, Inc., 1966.

*In Appendix A only.
**In Appendix C only.

Farrell, W. T., Stone, C., & Yoder, D. Guidelines for sampling in Marine Corps task analysis (Tech. Rep.). Los Angeles: Office of Naval Research (Contract No. N00014-74-A-0436-0001), California State University, March 1976.

Frankel, M. R. Inference from survey samples: An empirical investigation. Ann Arbor: The University of Michigan, 1971.

*Hamer, R. Assessing the comparability of similarity measures. Unpublished Master's Thesis, North Carolina State University, 1976.

**Harman, H. H. Modern factor analysis (2nd Ed.). Chicago: University of Chicago, 1967.

Hartley, C., Brecht, M., Pagerey, P., Weeks, G., Chapanis, A., & Hoecker, D. Subjective time estimates of work tasks by office workers. Journal of Occupational Psychology, 1977, 50, 23-26.

Hays, W. L. Statistics. New York: Holt, Rinehart, and Winston, Inc., 1963.

ISSC--Integrated Software Systems Corporation. Display plotting system (3rd Ed.). San Diego: Author, 1973.

Kish, L. Survey sampling. New York: John Wiley and Sons, Inc., 1965.

Lewis, D. Quantitative methods in psychology. New York: McGraw-Hill Book Company, Inc., 1960.

McCormick, E. J. Job and task analysis. In M. D. Dunnette (Ed.), Handbook of industrial and organizational psychology. Chicago: Rand McNally College Publishing Company, 1976, p. 670.

Moonan, W. J. On the problem of sample size or multivariate simple random sampling. Journal of Experimental Education, 1954, 22(3), 285-288.

**Orr, D. B. A new method for clustering jobs. Journal of Applied Psychology, 1960, 44(1), 44-49.

Parten, M. Surveys, polls, and samples: Practical procedures. New York: Harper and Brothers, 1950.

Pass, J. J., & Robertson, D. W. The subjective analysis of work: Developing effective survey strategies. Paper presented at the Annual Convention of the American Psychological Association, New York, September 1979.

**Tucker, L. R. A method of synthesis of factor analysis studies (PRB Rep. No. 984). Washington, DC: Department of the Army, Personnel Research Section, March 1951.

Walker, H. M., & Lev, J. Elementary statistical methods (3rd Ed.). New York: Holt, Rinehart, and Winston, 1969.

*Ward, J. H., Jr. Hierarchical grouping to maximize payoff (Tech. Note WADD-TN-61-29). San Antonio, TX: Personnel Laboratory, Wright Air Development Division, Air Research and Development Command, USAF, March 1961.

*In Appendix A only.
**In Appendix C only.

Weissmuller, J. J., Barton, B. B., & Rogers, C. R. CODAP: Source program listings for the Univac 1108 (AFHRL-TR-74-83). Brooks Air Force Base, TX: Air Force Human Resources Laboratory, Computational Sciences Division, October 1974.

Wolfe, J. H. Pattern clustering by multivariate mixture analysis. Multivariate Behavioral Research, 1970, 5(3), 329-350.

APPENDIX A

DESCRIPTION OF INVENTORY SCALES, CODAP JOB DESCRIPTION PROFILES, AND CODAP CLUSTERING PROCEDURE

DESCRIPTION OF INVENTORY SCALES, CODAP JOB DESCRIPTION PROFILES, AND CODAP CLUSTERING PROCEDURE

Scales

1. Relative Time-Spent--A five-point Likert-type scale of time spent performing a task relative to other job tasks, with scale points ranging from "very much" through "average" to "very little." (While the Navy's task analysis program employed the five-point Time-Spent scale, other military services use a seven- or nine-point scale.)

2. Relative Time-Spent Percentage--This is not a true "response" scale; rather, it is a conversion of the Relative Time-Spent scale responses to percentages that sum to 100 percent for all tasks performed by one individual. A simplified illustration for five tasks (versus the usual 400 to 600 tasks) is presented below:

Task	Relative Time-Spent Response	Relative Time-Spent Percentage
1	1 (very little)	10
2	3 (average)	30
3	1	10
4	1	10
5	4 (above average)	40
	10	100%

3. Task-Performed--A dichotomous (or two point) scale on which a "1" indicates task performed; and a "0", task not performed. A job incumbent's mark versus no mark on some point of the Relative Time-Spent scale converts, respectively, to scores of 1 or 0 on the Task-Performed scale.

Job Description Profiles

1. MP--Percent of Members Performing (the task)--the percentage of scores of "1" on the Task-Performed scale for each inventory task for a particular sample or cluster of individuals (i.e., the term cluster refers to a mathematically derived group of incumbents who perform similar work tasks).

2. TSM--Average Percent Time-Spent by All Members--the average of Relative Time-Spent percentages across all incumbents in the sample or cluster for each task in the inventory.

3. TSMP--Average Percent Time-Spent by Members Performing (the task)--the average of Relative Time-Spent percentages across only those respondents in the sample or cluster actually performing each task (as indicated by a response on one of the Relative Time-Spent scale points).

Clustering Similarity Index

1a. Overlap Between--Individuals. The sum of the smaller of the two percentages in the comparison of two incumbent's Relative Time-Spent percentages on tasks. Example:

Task	Incumbent A	Incumbent B	Percent Overlap
1	10	100	10%
2	90	0	0%
		Overlap Between =	10%

1b. Overlap Between--Clusters. The average of the Overlap Between values for each individual in one cluster with each of the individuals in the other cluster. The Overlap Between Index is the similarity measure used by the CODAP clustering procedure (described below). It should be emphasized that the values of this index do not reflect mean or level differences between Relative Time-Spent percentages for tasks as much as would values based on a distance measure (see Cronbach & Gleser, 1953) or the values of the TSMP profile and the TSM profile. The difference in the information contained in these measures is illustrated by the following example:

Task	Relative Time-Spent by Incumbent A	Relative Time-Spent by Incumbent B	Percent Overlap	Task Distance	Average Percent Time-Spent TSMP	Average Percent Time-Spent TSM
1	10	50	10	40	30	30
2	10	10	10	0	10	10
3	70	10	10	60	40	40
4	10	20	10	10	15	15
5	0	10	0	10	10	5
			Overlap Between=40	Total Distance=120		

The varying differences between the A and B Relative Time-Spent values are not reflected in the Percent Overlap or Overlap between values as they are in the distance and Average Percent Time-Spent values. Furthermore, previous research (Hamer, 1976) on the comparability of similarity indices indicates very high comparability (r = .90 df = 48) between Overlap Between values and Pearson correlation coefficients used to measure similarity between jobs. It should also be emphasized that the TSM values will be almost always more closely related than TSMP values to the Overlap Between values (i.e., summed percent overlap values). That is, a zero percent overlap value for a task will correspond to a TSM value that is closer to zero than the TSMP value.

Clustering Procedure

The CODAP clustering program is based on the Ward hierarchical cluster analysis procedure (Ward, 1961; Christal & Ward, 1967). The procedural steps are outlined below.

1. Calculate Overlap Between values for all possible pairs of job incumbents (see sample matrix below).

	Overlap Between Matrix			
Incumbent	A	B	C	D
A	100	10	30	50
B	10	100	40	70
C	30	40	100	60
D	50	70	60	100

2. Combine (cluster) the two incumbents with the highest Overlap Between value (in the above matrix, incumbents B and D would be clustered).

3. Continue to combine individuals and/or clusters by highest (average, if clusters) Overlap Between percentages, for a number of stages equal to N-1 incumbents, until all incumbents have been clustered into one total group. This agglomerative procedure results in a hierarchial solution; that is, the smaller clusters are subsumed by larger clusters.

4. For each cluster derived, calculate an Overlap Within index value as an indicator of cluster homogeneity. This index is the average of Overlap Between values, including redundant and diagonal values, for individuals contained in a cluster. Given the above sample Overlap Between matrix, the Overlap Within for a cluster containing individual C and D would equal (100 + 60 + 60 + 100) ÷ 4 = 80 percent. It should be noted, however, that the inclusion of diagonal values in the calculation of the Overlap Within index will cause those index values always to be higher, and, at times (depending on N of cluster membership and Overlap Between values), substantially higher, than the Overlap Between values. This instability of the Overlap Within index is illustrated by clusters obtaining very similar Overlap Between values but very different Overlap Within values, as displayed in typical output of CODAP's (OVLGRP) program. Thus, the Overlap Between index, and not the Overlap Within index, was used as an indicator of homogeneity for selecting clusters for stability evaluation.

APPENDIX B

SIZE AND COMPOSITION OF SAMPLES FOR NAVY RATINGS ANALYZED

Table B-1

Population and Total Sample Size by Pay Grade
for Selected Ratings

Pay Grade	Population N	Population % Pop	Total Sample N	Total Sample % Sample
AD Rating[a]				
2	1278	8.9	135	5.3
3	1525	10.7	297	11.7
4	3390	23.7	565	22.3
5	3384	23.7	674	26.6
6	2666	18.6	562	22.1
7	1276	8.9	215	8.5
8	430	3.0	62	2.4
9	347	2.4	40	1.6
Total	14296	99.9	2550	100.0
ET Rating[b]				
2	--	--	--	--
3	874	9.6	208	8.2
4	2492	27.5	748	29.4
5	3001	33.2	797	31.3
6	1653	18.3	506	19.9
7	666	7.4	197	7.7
8	237	2.6	66	2.6
9	127	1.4	24	0.9
Total	9050	100.0	2546	100.0
TM Rating				
2	--	--	--	--
3	--	--	--	--
4	982	39.1	205	27.9
5	756	30.1	251	34.1
6	521	20.7	183	24.9
7	182	7.2	71	9.7
8	61	2.4	21	2.9
9	11	0.4	4	0.5
Total	2513	99.9	735	100.0
YN Rating				
2	--	--	--	--
3	1607	16.3	415	15.0
4	2609	26.5	852	30.7
5	2246	22.8	680	24.5
6	1758	17.9	485	17.5
7	1228	12.5	266	9.6
8	303	3.1	53	1.9
9	96	1.0	21	0.8
Total	9847	100.1	2772	100.0

Notes.

1. Population refers to number of personnel (not billets) in rating. Total samples were provided by NODAC.
2. Sample Ns exclude personnel in instructor and student billets.
3. Pay grade 1 (E-1) personnel are not sampled since they do not have a rating.
4. Available records of population sampled showed Ns combined for pay grades 2 and 3 for ET and YN ratings, and combined for pay grades 2 through 4 for TM rating. Thus, the sample Ns for these pay grades are similarly combined.

[a]For pay grade 9, only ADs (N = 28), not AMs (N = 12), were analyzed.

[b]Ns exclude nuclear plant operators and supervisors. Total sample included late processed data for 87 personnel.

Table B-2

Types of Activities Represented in the AD and ET Rating Samples

Activity Type	Number of Activities	Number of Personnel
AD Rating Sample		
Attack Aircraft Carrier (CVA)	1	4
FAU COMNAVAIRPAC	1	1
NAVAIREWORKFAC	2	9
Naval Air Facility, Washington, DC	1	26
Naval Air Reserve Units (NARU)	6	29
Naval Air Stations (NAS)	10	564
Naval Air Training Center (NATC)	1	62
NAV Missile Center Point Mugu	1	35
Pacific Missile Range	1	5
COMNAVAIRPAC NALCO COMP	1	2
PATWING II	1	2
LATWINGPAC	1	1
Helicopter Combat Support Squadron (HC)	8	76
Helicopter Anti-Submarine Squadron (HS)	8	61
Helicopter Mine Countermeasures Squadron (HM)	1	23
Helicopter Anti-Submarine Squadron, Light (HSL)	7	70
Reconnaissance Squadron (RVAH)	2	33
Attack Squadron (VA)	19	271
Land Based Weather Reconnaissance Squadron (VW)	1	26
Patrol Squadron (VP)	17	239
Fighter Squadron (VF)	16	181
Fleet Composite Squadron (VC)	6	58
Air Anti-Submarine Squadron (VS)	10	128
Photographic Squadron (VFP)	2	17
Carrier Airborne Early Warning Squadron (VAW/RVAW)	6	89
Fleet Air Reconnaissance Squadron (VQ)	1	13
Fleet Tactical Support Squadron (VR)	4	82
Tactical Electronic Warfare Squadron (VAQ)	5	62
Fleet Tactical Support Squadron (VRC)	1	9
Aircraft Ferry Squadron (VRF)	2	10

Note. Data for AD rating sample from Halnon, T. D. and Gongloff, R. P. Occupational Analysis of the Aviation Machinist's Mate (AD) and Master Chief Aircraft Maintenanceman (AFCM) Ratings (Tech. Rep. NOTAP 76-3). Washington, DC: Occupational Task Analysis Program, December 1975. Data for ET sample from NOTAP unpublished report, Occupational Analyses of the ET ratings.

[a]Eighteen cases were dropped due to data deficiencies; total analyzed: 2550.

[b]Six cases were dropped due to data deficiencies; total analyzed: 2459 plus late processed data for 87 personnel for total N = 2546.

Table B-2 (Continued)

Activity Type	Number of Activities	Number of Personnel
Air Test and Evaluation Squadron (VX)	2	23
Antarctic Development Squadron (VXE)	1	22
HELTRARON	2	73
TRARON	8	213
TRAWING	1	1
NAVFITWEPSCOL	1	8
Total	158	2568[a]
ET Rating Sample		
Auxiliary Ships (AD/AG/AGDE(AGFF)/AGDS/AGSS/ ARS/AS/ASR/ATF/ATS/AVM)	34	403
Underway Replenishment Group (AE/AFS/AO/AOR)	8	29
Cruisers (CG/CGN)	11	105
Aircraft Carriers (CVA/CVAN)	8	228
Destroyers (DD/DDG)	40	214
Escort Ships (DE(FF)/DEG(FFG))	21	95
Amphibious Warfare Ships (LKA/LPA/LPD/LPH/ LSD/LST)	21	119
Mine Warfare Ships (MSC/MSO)	4	13
Patrol Ships (PG)	2	3
Submarines (SS/SSN)	25	97
Submarines--Ballistic Missile (SSBN)	26	120
Communications Stations	19	420
Naval Air Stations	15	267
Small Craft/Shore Duty Elements	8	(33)
DATC	3	33
Training Centers	7	34
Squadrons/Staffs/Commands	6	19
MOTU	5	75
Naval Stations	7	58
Miscellaneous	19	100
Total	289	2465[b]

Note. Data for AD rating sample from Halnon, T. D. and Gongloff, R. P. Occupational Analysis of the Aviation Machinist's Mate (AD) and Master Chief Aircraft Maintenanceman (AFCM) Ratings (Tech. Rep. NOTAP 76-3). Washington, DC: Occupational Task Analysis Program, December 1975. Data for ET sample from NOTAP unpublished report, Occupational Analyses of the ET ratings.

[a]Eighteen cases were dropped due to data deficiencies; total analyzed: 2550.

[b]Six cases were dropped due to data deficiencies; total analyzed: 2459 plus late processed data for 87 personnel for total N = 2546.

APPENDIX C

RATIONALE AND PROCEDURES FOR DETERMINING CLUSTER SOLUTION STABILITY

RATIONALE AND PROCEDURES FOR DETERMINING CLUSTER SOLUTION STABILITY

Rational for Matching Clusters

To determine cluster solution stability, the study executed a design analogous to that used or recommended for evaluating stability of factor analysis solutions (Aleamoni, 1973; Armstrong & Soelberg, 1968; Harman, 1967; Tucker, 1951). Essentially, this study's design consisted of two steps:

1. Matching clusters (factors are operated on in the analogue) across independent solutions on the basis of similarity to the total sample solutions (a description of the matching procedure appears in the next section of this appendix).

2. Determining the degree of similarity between total sample clusters and matched clusters from reduced samples, as well as between matched clusters. (The similarity between clusters was measured by the indices described on pages 7 and 8 in the text.)

Measures of similarity between total and reduced sample clusters will yield spuriously high results, since reduced sample data are also contained in the total sample data (i.e., samples are not independent). This spuriousness, however, is not present in the measure of similarity between matched clusters. High similarity between matched clusters for two independent samples demonstrates that a stable, recurrent pattern (i.e., cluster solution) exists across the data from samples as well as, of course, in the combined-sample data.

Cluster Matching Procedure (in 5 Steps)

Step 1

For each rating and each pair of independent samples, an intercorrelation matrix of product moment coefficients (rs) was calculated. The selected clusters derived from one of the total samples analyzed (i.e., AD2000, ET2000, YN2000, or TM735) marked the row dimension of the matrix, and the selected clusters derived from the independent samples marked the column dimension (see the criteria for selecting clusters on page 6, and the sample matrix below).

	Independent Sample Clusters							
Total Sample Clusters	Sample A				Sample B			
	1	2	3	4	1	2	3	4
1	90	85	60	(45)	40	80	(70)	35
2	85	90	35	40	90	85	30	71
3	95	70	55	40	72	98	60	75
4	70	60	90	50	75	70	76	97

The correlations were performed on the Percent of Members Performing (MP) job description profile between clusters. In the calculation of the coefficients, tasks were treated as cases, and the percentages of members performing tasks were treated as scores. Scores of zero on corresponding tasks for any two cluster profiles were deleted from the calculation. With this correlational model, complete independence of scores did

not exist. That is, the same individuals provided responses for calculation of a percentage (i.e., score) for more than one task. Cragun and McCormick (1967) report, however, only minor inflation for coefficients derived with this same model. This correlational model is identical to that used to derive $\underline{r}_{TA}$ and $\underline{r}_{TB}$ values for matched clusters. In fact, the $\underline{r}_{TA}$ and $\underline{r}_{TB}$ values were generated by this matching procedure.

Step 2

A cluster in each independent sample was identified for matching if it obtained an $\underline{r}$ that was both the largest $\underline{r}$ for a row (i.e., for a total sample cluster) and the largest $\underline{r}$ for that cluster column. In the above matrix, three clusters from each sample meet this criterion, as indicated by the underlined coefficients (with decimals omitted), corresponding to Sample A clusters, A1, A2, A3, and Sample B clusters, B1, B2, and B4. Clusters from each sample with underlined coefficients in the same row were matched, as is the case for clusters A1 and B2, A2 and B1, and A3 and B4. Thus, each cluster in each of these pairs is a "counterpart" of the corresponding total sample cluster. The columns and rows (i.e., clusters) that contained an underlined coefficient were deleted from the respective Sample A or B matrix half, as can be illustrated by drawing lines through these rows and columns for both samples. Thus, the only remaining entries in the above matrix are the coefficients in parenthesis, 45 and 70, under clusters A4 and B3 respectively.

Step 3

Step 2 was reiterated for the remaining cluster entries in the matrix. A cluster was not identified, however, as matching if it obtained an $\underline{r}$ which was more than 10 correlation points smaller (an arbitrary criterion) than the largest $\underline{r}$ for a row in the complete matrix. Thus, in the above matrix, cluster B3 is identified for matching since it obtained a coefficient of 70. Cluster A4, which obtained a coefficient of 45, is not identified for matching since 45 is more than 10 points smaller than 90, the largest coefficient in that row. This criterion was used to avoid matching clusters that were not closely related to a total sample cluster.

Step 4

If steps 2 and 3 did not result in a unique pair of matched clusters identified for a particular total sample cluster, an independent sample cluster was allowed to be matched a second time if both of the following criteria were met:

1. The sample cluster obtained the largest (or within 10 points of the largest) row $\underline{r}$ for a particular total sample cluster.

2. There was a large correlation between the MP profiles of the two total sample clusters (demonstrated by an $\underline{r}$ equal to or greater than an arbitrarily selected value of .80--the correlational model used to calculate this $\underline{r}$ was the same model used to calculate the matrix coefficients as described in Step 1 above).

Step 5

If steps 1 through 4 did not result in a pair of matched clsuters for every total sample cluster, then additional clusters were selected by a second search of the independent sample cluster hierarchies according to the following criteria:

1. Substantial common membership with total sample clusters for which there was no corresponding matched pair (determined by examining case IDs).

2. Overlap Between index value no lower than 35 percent.

These additionally selected clusters were thus matched by their correspondence to the same total sample cluster. Pearson correlation coefficients were obtained between these matched clusters for the AD1000, ET1000, YN1000, and TM368 paired samples with corresponding total sample clusters according to the model described in Step 1; that is, $\underline{r}_{TA}$ and $\underline{r}_{TB}$ values were calculated. Extensive programming requirements prohibited the calculation of the $\underline{r}_{TA}$ and $\underline{r}_{TB}$ values for additionally selected clusters for all samples, although such Additional Clusters (ACs) were identified for each sample when necessary. Also, a count was made, for each sample, of the number of matched pairs of clusters that consisted of one or two Additional Clusters (labeled as N of Cluster Pairs--2nd search).

Common Membership in Matched Clusters

Rationale

The derivation of the Percent of Common Membership index was based on a design idea by Orr (1960). This index specifies the degree to which the same personnel from a holdout sample were assigned to each cluster in a matched pair of clusters. When Percent of Common Membership values (i.e., percentages) are averaged over all matched clusters for any two paired samples (i.e., sample A and sample B), the result indicates the degree to which a similar pattern or cluster solution was obtained across samples--the higher the average percentage value, the higher the cluster solution stability.

Assignment of Holdout Group of Individuals

Any set of matched clusters consists of a set of sample A clusters and a set of sample B clusters (see the Cluster Matching Procedure section of this appendix). In the derivation of the Percent of Common Membership index, individuals from a holdout group were assigned, separately, to sample A clusters and to sample B clusters. The following two methods of assignment were used, each based on a different measure of profile similarity:

1. Percent of Common Membership--Time-Spent Method. Assignment of individuals was determined by the value of the sum of absolute difference (i.e., distance) between percentages on corresponding tasks of the Average Percent Time-Spent by All Members (TSM) profile for clusters with the individual's Relative Time-Spent percentages. Assignment was made to the cluster with the smallest distance value.

2. Percent of Common Membership--Task-Performed Method. Cluster assignment was determined by the largest point-biserial correlation between the individual's Task-Performed scores (i.e., 0 for task not performed, and 1 for task performed) and the Percent of Members Performing (MP) profile for clusters. This correlational model treated tasks as cases, and scores of zero on corresponding tasks were included.

Calculation of Index

The Percent of Common Membership, based on either assignment method, equaled twice the number of personnel assigned in common to each pair of matched clusters, divided by the total number of personnel assigned to each pair, and multiplied by 100. For example, the sample A and sample B cluster for one matched pair are

assigned 65 and 85 personnel respectively, and 65 are assigned in common. Thus, the Percent of Common Membership = $\frac{2 \times 65}{65 + 85}$ = .866 x 100 = 86.6%. A maximum stability value for this index occurs if both clusters are assigned only the same personnel (e.g., if both clusters are assigned the same 65 personnel, then index = $\frac{2 \times 65}{65 + 65}$ = 1.0 x 100 = 100%).

Finally, it should be noted that this index was subject to two sources of attenuation that the correlational indices were not—error due to individual data (versus mean data) being analyzed, and attenuation due to dependence between matching clusters within each paired sample. In regard to the latter, the higher the dependence (i.e., correlation between within-sample cluster profiles), the more probable it was that low index values would be obtained. To illustrate this point, consider that one sample A cluster in a pair of matched clusters is highly correlated with another sample A cluster. Therefore, holdout personnel with similar job description profiles will tend to be split (in assignment) between these two highly correlated sample A clusters, but assigned as a group to only one sample B cluster. Thus, in this case, the percentage of common membership between the matched clusters would be attenuated.

APPENDIX D

CORRELATIONS OF JOB DESCRIPTION PROFILES ACROSS AD RATING SAMPLES

Table D-1

Correlations of Job Description Profiles By
Pay Grade Across Paired AD Samples (50% of Total Sample)

Sample B: Pay Grade, N % of B % of (A+B)[a]	Statistic[b]	Sample A: Pay Grade, N % of A % of (A+B)	2, N=67 5.3% of A 2.6% of (A+B)	3, N=149 11.7% of A 5.9% of (A+B)	4, N=282 22.2% of A 11.1% of (A+B)	5, N=337 26.6% of A 13.3% of (A+B)	6, N=281 22.1% of A 11.1% of (A+B)	7, N=108 8.5% of A 4.3% of (A+B)	8, N=31 2.4% of A 1.2% of (A+B)	9, N=14 1.1% of A 0.6% of (A+B)	Totals N=1269 100% of A 50% of (A+B)
2, N=68	r_{MP}, r_{TSMP}		.95, -.02	.95, .11	.82, .05	.64, .28	.38, .21	.09, -.02	-.19, -.04	-.28, -.04	
5.4% of B	N Tasks		325	379	397	403	402	397	369	360	
2.7% of (A+B)	$\bar{X}_A$		5.2	13.6	33.8	47.7	42.3	16.5	3.8	1.6	
	$\bar{X}_B$		6.0	5.2	4.9	4.9	4.9	4.9	5.3	5.4	
3, N=148	r_{MP}, r_{TSMP}		.95, .14	.98, .12	.90, .17	.75, .10	.46, .21	.13, .14	-.17, .07	-.27, .06	
11.7% of B	N Tasks		362	388	398	403	402	400	389	384	
5.8% of (A+B)	$\bar{X}_A$		4.7	13.2	33.7	47.7	42.3	16.4	3.6	1.5	
	$\bar{X}_B$		14.4	13.4	13.1	12.9	12.9	13.0	13.4	13.5	
4, N=283	r_{MP}, r_{TSMP}		.82, .05	.88, .07	.99, .09	.93, .18	.61, .29	.18, .16	-.14, .23	-.25, .13	
22.3% of B	N Tasks		392	397	401	404	403	402	401	401	
11.2% of (A+B)	$\bar{X}_A$		4.3	12.9	33.5	47.5	42.2	16.3	3.5	1.4	
	$\bar{X}$		35.3	34.8	34.5	34.2	34.3	34.4	34.5	34.3	
5, N=337	r_{MP}, r_{TSMP}		.68, .15	.75, .16	.92, .17	.99, .37	.82, .40	.40, .28	.07, .38	-.06, .22	
26.6% of B	N Tasks		400	403	404	404	404	403	401	401	
13.3% of (A+B)	$\bar{X}_A$		4.2	12.8	33.2	47.5	42.1	16.3	3.5	1.4	
	$\bar{X}_B$		50.8	50.4	50.2	50.2	50.2	50.4	50.6	50.6	
6, N=281	r_{MP}, r_{TSMP}		.36, .11	.43, .06	.58, .13	.78, .62	.98, .56	.82, .32	.55, .37	.41, .29	
22.1% of B	N Tasks		400	404	404	404	404	404	401	400	
11.1% of (A+B)	$\bar{X}_A$		4.2	12.7	33.2	47.5	42.1	16.2	3.5	1.4	
	$\bar{X}_B$		40.4	40.0	40.0	40.0	40.0	40.0	40.3	40.4	
7, N=107	r_{MP}, r_{TSMP}		.04, -.04	.08, .21	.14, .14	.35, .47	.79, .45	.98, .39	.88, .59	.81, .57	
8.4% of B	N Tasks		390	400	403	404	401	400	388	387	
4.2% of (A+B)	$\bar{X}_A$		4.3	12.8	33.3	47.5	42.4	16.4	3.6	1.4	
	$\bar{X}_B$		16.3	15.9	15.8	15.8	15.9	15.9	16.4	16.5	
8, N=31	r_{MP}, r_{TSMP}		-.20, -.08	-.14, .12	-.12, .18	.06, .32	.53, .47	.87, .47	.94, .45	.91, .55	
2.4% of B	N Tasks		347	388	403	403	398	393	301	288	
1.2% of (A+B)	$\bar{X}_A$		4.9	13.2	33.3	47.7	42.7	16.7	4.6	1.9	
	$\bar{X}_B$		4.4	3.9	3.8	3.8	3.8	3.8	5.0	5.3	
9, N=14	r_{MP}, r_{TSMP}		-.31, -.17	-.24, .11	-.21, .15	-.04, .44	.40, .47	.76, .48	.83, .49	.81, .27	
1.1% of B	N Tasks		318	381	402	403	398	392	233	130	
0.6% of (A+B)	$\bar{X}_A$		5.3	13.4	33.4	47.7	42.7	16.7	6.0	4.3	
	$\bar{X}_B$		1.4	1.2	1.1	1.1	1.1	1.1	1.9	3.4	
Totals N=1269 100% of B 50% of (A+B)											

[a] % of (A+B) equals the combined Ns for Samples A and B, i.e., total or combined N = 2538.

[b] See page 5 for the calculation of the r_{MP} and r_{TSMP} coefficients.

Profile tasks which no pay grade member of either sample performed, were deleted because pairs of zero profile scores would spuriously inflate the obtained r values. Thus, the N tasks indicated for the pay grade comparisons is usually less than the total number of 404 inventory tasks for AD.

$\bar{X}_A$ and $\bar{X}_B$ were calculated, for sample A and B pay grades, by summing the number of members performing each task, and dividing that sum by N Tasks.

D-1

APPENDIX E

JOB DESCRIPTION PROFILES SORTED BY AVERAGE PERCENT TIME SPENT BY ALL MEMBERS (TSM) SCORES

	TM/3A JOBDEC	NOTAPI		
TASK JOB DESCRIPTION	CASES	TASKS	DUTIES	MEMBERS
	367	337	10	35

Table E-1

Job Description Profile Scores for TM Pay Grade E-7

D-Tsk	Task Title	Percent Members Performing	Avg. % Time Spent by Members Performing	Avg. % Time Time Spent by All Members	Cum. Sum of Avg. % Time Spent by All Members	No. Duties or Tasks
B 1	Write Enlisted Performance Evaluations	80.00	2.46	1.97	1.97	
A 1	Review Enlisted Performance Evaluations	82.86	2.32	1.93	3.90	
C 18	Maintain Logs (pass Down Log (PDL) etc.)	62.86	3.01	1.89	5.79	
B 4	Ensure Work Assigned to Subordinates is Completed	82.86	2.27	1.88	7.66	
C 6	Update Publications/Instructions (Pen and Ink and Page Changes)	80.00	2.28	1.82	9.49	5
B 5	Coordinate Work Within Division	68.57	2.56	1.76	11.25	
C 17	Fill Out Work Requests/Work Orders	62.86	2.42	1.52	12.77	
A 11	Evaluate Operational Commitments in Order to Schedule Workload	60.00	2.35	1.41	14.18	
A 5	Screen Messages, Bulletins, etc. for Appropriate Action	74.28	1.84	1.36	15.54	
A 2	Make Personnel Assignments	80.00	1.68	1.34	16.88	10
A 3	Assign Work Priorities	71.43	1.78	1.27	18.15	
C 7	Maintain Correspondence/Message Files	62.86	1.94	1.22	19.38	
A 24	Receipt for Weapons	71.43	1.68	1.20	20.58	
B 2	Make Work Assignments	74.28	1.56	1.16	21.74	
A 25	Ensure Readiness of Command for Inspections (Administrative Operational, Material, etc.)	68.57	1.66	1.14	22.88	15
A 15	Prepare Weekly Discrepancy Reports	54.28	2.01	1.09	23.97	
C 25	Prepare Reports of Unsatisfactory/Defective Torpedoes, or Equipment	65.71	1.64	1.08	25.05	
A 27	Review and Submit Status Reports (Performance, Inventory, Casualty, etc.)	62.86	1.64	1.03	26.08	
F 21	Inspect Weapons Handling Gear (Slings, Hoist, etc.)	68.57	1.37	0.94	27.02	
C 5	Maintain Tickler File	48.57	1.88	0.91	27.93	20
Z 9	Attend Meetings, Seminars, Conferences, etc.	54.28	1.68	0.91	28.84	
A 9	Monitor Training Program	57.14	1.54	0.88	29.72	
E 12	Inspect All Material Upon Receipt for Damage, Quality, Quantity, etc.	42.86	2.02	0.87	30.58	
Z 4	Stand Inspections	60.00	1.42	0.85	31.44	
C 11	Route Correspondence/Publications/Instructions, etc.	51.43	1.65	0.85	32.28	25

Table E-1 (Continued)

D-Tsk	Task Title	Percent Members Performing	Avg. % Time Spent by Members Performing	Avg. % Time Time Spent by All Members	Cum. Sum of Avg. % Time Spent by All Members	No. Duties or Tasks
A 18	Coordinate Weapon Overhaul and Repair Within Own Command and/or Between Other Ships and Stations	51.43	1.64	0.84	33.12	
A 20	Recommend Personnel for Formal Training	65.71	1.26	0.83	33.95	
D 11	Sign Off Practical Factors	71.43	1.14	0.81	34.76	
F 32	Turn in Torque Wrenches for Calibration	51.43	1.55	0.80	35.56	
C 39	Prepare/Update 3M Schedules (Cycle, Quarterly, Weekly)	54.28	1.42	0.77	36.33	30
C 1	Draft Naval Messages	48.57	1.58	0.76	37.09	
A 14	Sign Requisitions Requiring Approval	54.28	1.39	0.76	37.85	
C 8	Type Correspondence/Forms	40.00	1.82	0.73	38.58	
A 10	Represent Command at Conferences and Meetings	45.71	1.56	0.71	39.29	
Z 1	Hold Field Days, Sweepdowns, etc.	42.86	1.60	0.68	39.97	35
C 20	Update Recall Bill	37.14	1.84	0.68	40.66	
Z 6	Counsel Personnel on Personal/Military Matters	54.28	1.25	0.68	41.34	
D 2	Update Individual Training Records	45.71	1.48	0.68	42.01	
D 1	Prepare Individual Training Records	45.71	1.48	0.68	42.69	
C 35	Maintain Torpedo Record Book	51.43	1.32	0.68	43.36	40
A 7	Coordinate with Military Military Activities for Required	48.57	1.37	0.66	44.03	
F 62	Destroy Classified Materials in Accordance Current Instructions	51.43	1.29	0.66	44.69	
C 15	Draft Instructions/Notices	45.71	1.45	0.66	45.35	
D 3	Schedule Training Lectures	54.28	1.22	0.66	46.01	
C 24	Maintain Log/File of Report of Unsatisfactory/Defective Torpedoes or Equipment	57.14	1.14	0.65	46.66	45
C 16	Review/Chop Outgoing Correspondence/Messages	34.28	1.89	0.64	47.31	
A 22	Maintain Liaison with Personnel of Other Departments to Prevent or Correct Interface Problems	45.71	1.41	0.64	47.95	
B 7	Complete Weapons Firing Reports	45.71	1.40	0.64	48.58	
C 13	Maintain Status Boards	57.14	1.10	0.63	49.21	
Z 5	Attend General Drills	48.57	1.28	0.62	49.83	50
A 19	Determine Expendable Materials (Surveys, Disposal, etc.)	51.43	1.19	0.61	50.44	
A 16	Evaluate and Take Appropriate Action on Reports from Torpedo Readiness Acceptance (TRAT) Inspection	51.43	1.16	0.60	51.04	
F 53	Perform Weapons Receipt Inspection	54.28	1.09	0.59	51.63	
A 4	Write Billet/Job Descriptions	45.71	1.28	0.58	52.22	
E 17	Pack/Unpack Weapons/Components	48.57	1.20	0.58	52.80	55
J 41	Perform Quality Assurance Checks on Weapons	17.14	3.37	0.58	53.37	
C 19	Maintain Leave Schedules	45.71	1.23	0.56	53.94	
C 29	Make Entries in Daily Work Log	40.00	1.40	0.56	54.50	
F 61	Participate in Weapons Firefighting Procedures	45.71	1.22	0.56	55.06	
C 14	Distribute Safety Material (Publications, Posters, etc.)	51.43	1.06	0.55	55.60	60

Table E-1 (Continued)

D-Tsk	Task Title	Percent Members Performing	Avg. % Time Spent by Members Performing	Avg. % Time Time Spent by All Members	Cum. Sum of Avg. % Time Spent by All Members	No. Duties or Tasks
E 1	Order Parts, Tools, Supplies, etc.	57.14	0.95	0.54	56.14	
C 12	Maintain Division Officer's Notebook	31.43	1.67	0.52	56.67	
A 23	Organize Departmental/Division Security	42.86	1.20	0.52	57.18	
F 1	Test Weapons Security Alarm Systems	51.43	1.00	0.51	57.70	
C 2	Draft Naval Letters	34.28	1.46	0.50	58.20	65
F 44	Remove/Install Weapons/Components in Shipping Containers	42.86	1.16	0.49	58.69	
D 22	Develop On-the-Job Training (OJT) Program	45.71	1.07	0.49	59.18	
Z 8	Conduct Inspections (Zone, Personnel, Safety, etc.)	48.57	1.01	0.49	59.66	
F 8	Chip, Preserve, and Paint Topside Areas	11.43	0.76	0.08	95.28	
F 24	Operate Forklift	5.71	1.50	0.08	95.37	
H 17	Install Battery Power Supplies	14.28	0.60	0.08	95.45	
F 7	Handle and Fire Pyrotechnic Devices	17.14	0.50	0.08	95.53	
D 20	Prepare and Administer Feedback Reports for the Purpose of Updating Training	11.43	0.71	0.08	95.61	230
C 26	Prepare Corrective Action Request (NAVORD Form 4855/18)	11.43	0.70	0.08	95.69	
F 25	Maintain/Use Hydraulic RAM	11.43	0.70	0.08	95.77	
G 22	Electrically Zero Synchros/Servos	8.57	0.98	0.08	95.85	
G 10	Remove/Replace Components on Printed Circuit Boards	8.57	0.96	0.08	95.93	
G 9	Repair Cables (Splices, etc.)	8.57	0.94	0.08	96.01	235
F 14	Perform Emergency De-Fueling Procedures on Weapons	11.43	0.67	0.08	96.09	
J 30	Overhaul and Repair Pneumatic Actuated Valves	5.71	1.38	0.08	96.17	
C 32	Prepare Work Request Customer Service Form (OPNAV Form 4790/36A)	8.57	0.88	0.07	96.24	
D 10	Prepare Test/Examinations	11.43	0.64	0.07	96.31	
D 16	Construct Training Aids	11.43	0.64	0.07	96.38	240
F 5	Maintain Small Arms (Clean, Lubricate, etc.)	14.28	0.51	0.07	96.45	
J 18	Test Weapons Homing Control Logic Unit	5.71	1.25	0.07	96.52	
J 23	Test Weapons Velocity Switches	11.43	0.62	0.07	96.66	
H 33	Maintain Torpedo Tube Electrical System	11.43	0.61	0.07	96.73	245
F 33	Calibrate Torque Wrenches	14.28	0.50	0.07	96.79	
J 57	Test Missile Igniter	8.57	0.78	0.06	96.86	
C 37	Review/Update Casualty Reports (CASREPTS)	8.57	0.78	0.06	96.92	
F 42	Operate Forward/Aft Capstan	11.43	0.57	0.06	96.99	
J 10	Service Weapons Hydraulic Systems	5.71	1.16	0.06	97.05	250
J 43	Fuel/De-Fuel Weapons	14.28	0.46	0.06	97.11	
D 21	Prepare Programmed Instructions	8.57	0.74	0.06	97.17	
F 48	Inspect/Test-Operate Magazine De-Watering Systems	8.57	0.70	0.06	97.23	
H 11	Perform Final Preparation of Complete Torpedo (MK-16)	17.14	0.35	0.06	97.29	
D 25	Train Instructors in OJT Methods	8.57	0.66	0.06	97.35	255

Table E-1 (Continued)

D-Tsk	Task Title	Percent Members Performing	Avg. % Time Spent by Members Performing	Avg. % Time Time Spent by All Members	Cum. Sum of Avg. % Time Spent by All Members	No. Duties or Tasks
J 31	Overhaul and Repair Mechanical Depth Mechanisms	2.86	2.00	0.06	97.41	
J 17	Remove/Replace Weapons Propulsion Battery	8.57	0.70	0.06	97.46	
J 14	Overhaul and Repair Weapon Turbine Propulsion Unit	2.86	2.00	0.06	97.52	
F 79	Install Safety Wire	8.57	0.69	0.06	97.57	
J 33	Overhaul and Repair Mechanical Steering Units	2.86	2.00	0.06	97.63	260
J 20	Repair Weapons Gyros	2.86	2.00	0.06	97.69	
H 19	Remove/Replace Thrust Reversal Nozzle Plug	11.43	0.50	0.06	97.74	
H 13	Perform Abort Procedures on Weapons	14.28	0.42	0.06	97.80	
F 78	Neutralize Electrolyte Spillage (Acid, Alkaline)	8.57	0.65	0.05	97.85	
Z 14	Stand Special Sea Detail Watches (Helmsman, After Steering, Line Handler, etc.)	8.57	0.62	0.05	97.90	265
F 65	Clean/Repair Liquid Stowage Tanks	5.71	0.88	0.05	97.95	
J 49	Install Electrolyte in Weapons Batteries	8.57	0.60	0.05	98.00	
J 9	Perform Torpedo Receiver Sensitive Test	5.71	0.86	0.05	98.05	

TASK JOB DESCRIPTION	CASES	TASKS	DUTIES	MEMBERS
	1386	529	18	340

Table E-2

Job Description Profile Scores for YN Pay Grade E-5

D-Tsk	Task Title	Percent Members Performing	Avg. % Time Spent by Members Performing	Avg. % Time Time Spent by All Members	Cum. Sum of Avg. % Time Spent by All Members	No. Duties or Tasks
H 43	Type Standard Naval Letters	75.00	2.25	1.69	1.69	
Z 34	Stand Inspections	63.82	1.92	1.22	2.91	
F 65	Screen Messages, Correspondence, and Publications for Appropriate Action	55.59	2.18	1.21	4.12	
H 39	Type Endorsements	68.53	1.76	1.20	5.32	
G 7	Sort/Distribute Mail	54.12	2.21	1.20	6.52	5
F 6	Ensure Work Assigned to Subordinates is Completed	53.53	2.22	1.18	7.70	
E 1	Order Parts, Tools, or Supplies	54.70	2.02	1.11	8.81	
Z 1	Hold Field Days/Sweepdowns	44.41	2.45	1.08	9.89	
F 13	Organize/Assign Files in Accordance with Navy Standard Subject Identification Codes (SSIC)	57.06	1.90	1.08	10.98	
H 10	Proofread/Edit Correspondence	57.35	1.88	1.08	12.06	10
H 17	Prepare/Type Instructions	53.53	1.94	1.04	13.09	
Z 10	Stand Telephone/Desk Watch	43.53	2.38	1.03	14.12	
H 7	Pickup/Delivery Messages	42.06	2.35	0.99	15.11	
L 7	Place Telephone Calls for Superiors	53.23	1.78	0.94	16.06	
J 1	Update Publications/Instructions (Such as Pen and Ink/Page Changes)	57.94	1.62	0.94	17.00	15
E 9	Store/Preserve Office Supplies or Equipment	49.70	1.83	0.91	17.90	
H 42	Type Business Style Letters	52.94	1.68	0.89	18.80	
H 5	Prepare/Maintain Tickler File	44.41	1.91	0.85	19.64	
G 24	Ensure Action Due Date(s) is Compiled with (Such as Correspondence, Messages, Reports)	40.29	2.06	0.83	20.47	
H 2	Draft Standard Naval Letters	54.41	1.52	0.82	21.30	20
J 2	Maintain Current Manuals/Publications	50.59	1.63	0.82	22.12	
H 18	Prepare/Type Notices	50.59	1.58	0.80	22.92	
H 46	Maintain Master File of Instructions/Notices	42.35	1.83	0.78	23.69	
H 21	Type Unclassified Non-OCR Messages	40.88	1.87	0.76	24.46	
H 14	Type Letters of Appreciation/Commendation	45.88	1.63	0.75	25.20	25
F 7	Coordinate Work Within Division	36.47	2.01	0.73	25.94	
H 1	Draft Naval Messages	45.29	1.62	0.73	26.67	
F 29	Clean/Lubricate and Make Minor Adjustments to Office Equipment (such as Typewriters, Reproduction Machines)	48.53	1.51	0.73	27.40	
M 13	Type Officer Report of Home of Record and Place from Which Ordered to a Tour of Active Duty (NAVPERS 1070/74)	10.59	0.87	0.09	88.64	
F 57	Prepare/Type Budget/OPTAR Reports	5.88	1.50	0.09	88.73	
F 35	Monitor Force/Command Forms Management Program	7.06	1.30	0.09	88.82	
P 11	Grade Tests/Examinations	5.59	1.58	0.09	88.91	265

Table E-2 (Continued)

D-Tsk	Task Title	Percent Members Performing	Avg. % Time Spent by Members Performing	Avg. % Time Time Spent by All Members	Cum. Sum of Avg. % Time Spent by All Members	No. Duties or Tasks
P 14	Prepare Certificate of Advancement/Appointment Letters	8.53	1.06	0.09	88.99	
T 27	Prepare/Type Request for Statement of Service	8.53	1.04	0.09	89.08	
H 38	Draft Joint Letters	8.82	1.00	0.09	89.17	
F 56	Maintain Budget/OPTAR Records	5.00	1.83	0.09	89.26	
D 8	Prepare Tests/Examinations	7.06	1.21	0.08	89.34	270
P 23	Process Student Enrollments, Disenrollments, Graduations	2.64	3.22	0.08	89.43	
V 10	Verify Suspect's Rights Acknowledgement/Statement (NAVJAG 5810/10)	7.64	1.11	0.08	89.51	
V 5	Prepare/Type Prisoner Release Order (DD Form 367)	7.64	1.10	0.08	89.59	
Q 11	Prepare/Type Navy Sponsor Notification (NAVPERS 1330/2)	7.94	1.10	0.08	89.68	
D 14	Construct Training Aids	8.82	0.99	0.08	89.76	275
F 26	Evaluate Operational Commitments in Order to Schedule Workload	5.29	1.66	0.08	89.85	
K 6	Prepare Transparencies	5.00	1.64	0.08	89.93	
F 16	Issue/Control School Quotas	5.00	1.62	0.08	90.01	
T 6	Control/Issue Identification (I.D.) Cards	7.35	1.14	0.08	90.09	
F 43	Determine Most Cost-Effective Means of Office Operations	6.47	1.24	0.08	90.17	280
N 22	Verify Enlisted Distribution and Verification Report (NMP) (BUPERS Report 1080-14)	5.59	1.45	0.08	90.25	
J 19	Prepare/Type Summarization/Narrative Memos (such as Special Project, Studies)	5.29	1.54	0.08	90.33	
S 8	Prepare/Type Request for Tango Number (S)	8.53	0.98	0.08	90.41	
D 16	Conduct Training Programs in JUMPS/MAPMIS Procedures	8.53	0.98	0.08	90.49	
Z 24	Stand Colors Detail	5.59	1.42	0.08	90.56	285
K 1	Maintain Status Boards (such as VIDS)	5.00	1.60	0.08	90.64	
L 1	Prepare/Type Admiral's/Captain's/XO's Schedule	5.29	1.46	0.08	90.71	
F 25	Review/Update (Command's) Ship's Organization and Regulation Manual (SORM)	6.47	1.19	0.08	90.79	
V 24	Prepare/Type Recommendation for Discharge by Reason of Unsuitability	6.76	1.16	0.08	90.87	
T 24	Prepare/Issue Meal (Chow) Pass (ES)	5.59	1.40	0.08	90.94	290
Y 9	Maintain Chaplain's Interview Records	1.76	4.33	0.08	91.02	
T 48	Prepare/Type Notice of Change of Address (OPNAV 2700/5)	6.47	1.23	0.08	91.09	
H 35	Prepare Records Transmittal or Receipt Form (STD Form 135)	7.35	1.05	0.08	91.17	
Q 12	Prepare/Type Application for Transportation of Dependents (DD 884)	7.64	1.01	0.08	91.25	
D 4	Review Lesson Guides (Instructor Guides) for Accuracy/Comp.	8.53	0.92	0.08	91.32	295

Table E-2 (Continued)

D-Tsk	Task Title	Percent Members Performing	Avg. % Time Spent by Members Performing	Avg. % Time Time Spent by All Members	Cum. Sum of Avg. % Time Spent by All Members	No. Duties or Tasks
H 55	Edit Material Produced by Word Processing Card/Tape	4.12	1.78	0.07	91.39	
P 4	Prepare Recommendation for Advancement in Rate or Change in Rating Worksheet (NAVPERS 1430/2)	6.18	1.18	0.07	91.47	
P 3	Request School Quotas	6.76	1.10	0.07	91.54	
S 11	Prepare/Type Military Authorization (MTA) (DD 1482)	6.76	1.09	0.07	91.61	
K 13	Prepare/Type Command Newspaper/Bulletin	6.18	1.21	0.07	91.68	300
T 42	Prepare/Type Photographic Job Order Request (S)	3.82	1.98	0.07	91.75	
G 12	Prepare Mailing Address Plates	4.41	1.54	0.07	91.82	
J 18	Follow-up Situation Report (SITREP)	4.70	1.45	0.07	91.89	
N 20	Prepare/Maintain Enlisted Diary (NAVPERS 1070/75)	3.82	1.82	0.07	91.96	
S 4	Prepare/Type Military Pay Order (Multiple) (NAVCOMPT 3061)	7.94	0.86	0.07	92.03	305
P 9	Order Tests/Examinations	4.12	1.57	0.06	92.09	
V 25	Prepare/Type Recommendation for Discharge by Reason of Unfitness	5.88	1.12	0.06	92.15	
F 23	Sign Correspondence, Service Record Entries, Orders, etc. (Authorized to Sign by Direction)	4.41	1.52	0.06	92.22	
V 7	Counsel/Assist Personnel on Legal Assistance Program	5.29	1.21	0.06	92.28	
M 16	Prepare/Type Annual Qualifications Questionnaire Inactive Duty Reserve Officers (NAVPERS 121072)	6.76	0.99	0.06	92.35	310
T 4	Prepare/Type Enlisted Transfer and Special Duty Request (NAVPERS 1306/7)	6.76	0.97	0.06	92.41	
Q 27	Counsel/Assist Personnel on Household Goods (HHG/Shipments)	7.06	0.95	0.06	92.47	
R 4	Prepare/Type Survivor Benefit Plan Letter to Wife	7.06	0.94	0.06	92.54	
T 34	Prepare/Maintain Officer Manning Roster	7.06	0.93	0.06	92.60	
E 6	Draft Surveys on Lost or Damaged Equipment	7.35	0.89	0.06	92.67	315
R 5	Prepare/Type Discharge Certificate (S)	7.64	0.84	0.06	92.73	
R 1	Prepare/Type Application for Voluntary Retirement/ Resignation	7.94	0.82	0.06	92.79	
T 3	Prepare/Type Enlisted Duty Preferences (NAVPERS 1306/63)	8.23	0.81	0.06	92.86	
Q 10	Prepare/Type Request for Passports	5.29	1.13	0.06	92.92	
V 22	Advise Accused of Hearing/Appellate Rights	5.00	1.22	0.06	92.98	320
E 11	Determine Most Cost-Effective Means of Procuring Open Purchase Items	5.59	1.11	0.06	93.04	
F 55	Determine Budget Requirements	3.82	1.58	0.06	93.10	
N 24	Verify Enlisted Service Record (S)	5.00	1.23	0.06	93.16	
T 20	Prepare/Type Request for and Certification of Eligibility (DD 802)	5.88	1.07	0.06	93.22	
P 12	Administer Tests/Examinations (such as Performance, Written)	4.70	1.35	0.06	93.28	325

Table E-2 (Continued)

D-Tsk	Task Title	Percent Members Performing	Avg. % Time Spent by Members Performing	Avg. % Time Time Spent by All Members	Cum. Sum of Avg. % Time Spent by All Members	No. Duties or Tasks
H 11	Package Files for Transmittal to Federal Records Center	5.88	1.05	0.06	93.34	
P 13	Disseminate Examination Results	5.29	1.19	0.06	93.40	
F 42	Determine Most Cost-Effective Means of Printing/ Reproduction	6.18	1.03	0.06	93.46	
F 24	Draft Replies to Congressional Inquiries	6.47	0.94	0.06	93.52	
Y 1	Type Church Services Bulletin	1.47	4.09	0.06	93.58	330
R 3	Prepare/Type Survivor Benefit Plan-Election Certificate (DD 1883)	7.06	0.90	0.06	93.64	
T 39	Maintain "Aviators Flight Log Book" (OPNAV 3730-31)	2.35	2.69	0.06	93.70	
D 11	Update Training Material (such as Instructor Guides, Plans)	7.64	0.80	0.06	93.76	
S 1	Prepare/Type Family Separation Allowance Form (Single) (NAVCOMPT 3057)	9.12	0.67	0.06	93.82	

APPENDIX F

STABILITY RESULTS OF AVERAGE TASK-PERFORMED SCALE RESPONSES FOR PAY GRADES

Table F-1

Stability of Percent of Members Performing (MP)
Profile Across AD1269 Samples (50% of Total Sample)

Pay Grade	N Incumbents Sample A	N Incumbents Sample B	r_{MP}	Total[a] N Tasks	Stability Indices: Tasks with Similar Percent of Members Performing by: Z-Difference[b] N Tasks	Z-Difference[b] Index Prop.	Percentage Point Difference Equal to or Less Than[c] 5% N Tasks	5% Index Prop.	10% N Tasks	10% Index Prop.	15% N Tasks	15% Index Prop.	20% N Tasks	20% Index Prop.
9	14	14	.81	130	99	.76	18	.14	74	.57	101	.78	101	.78
8	31	31	.94	301	275	.91	194	.65	267	.89	277	.92	294	.98
7	108	107	.98	400	368	.92	334	.83	395	.99	400	1.0	400	1.0
6	281	281	.98	404	375	.93	360	.89	403	1.0	404	1.0	404	1.0
5	337	337	.99	404	385	.95	383	.95	404	1.0	404	1.0	404	1.0
4	282	283	.99	401	373	.93	382	.95	401	1.0	401	1.0	401	1.0
3	149	148	.98	388	345	.89	370	.95	388	1.0	388	1.0	388	1.0
2	67	68	.95	325	295	.91	268	.83	315	.97	324	1.0	325	1.0
Total	1269	1269												

[a] The number of inventory tasks by pay grade (from total 404 tasks in AD inventory), excluding tasks score (0,0) (i.e, tasks not performed by any member in Sample A and B). Calculation of all stability indices was based on N in this column.

[b] A task was similar if percentage of MP between Samples A and B was not significantly different by Z-test (see page 5).

[c] A task was similar if percentage difference of MP between Sample A and B was within the value indicated--5, 10, 15, or 20. N Tasks is the number of Total N Tasks that were within percentage difference. Index Prop. is the proportion of inventory tasks (i.e., proportion of Total N Tasks) that were within percentage difference (see page 5).

Table F-2

Stability of Percent of Members Performing (MP)
Profile Across ET1275 Samples (50% of Total Sample)

Pay Grade	N Incumbents Sample A	N Incumbents Sample B	r_{MP}	Total[a] N Tasks	Stability Indices: Tasks with Similar Percent of Members Performing by: Z-Difference[b] N Tasks	Z-Difference[b] Index Prop.	Percentage Point Difference Equal to or Less Than[c]: 5% N Tasks	5% Index Prop.	10% N Tasks	10% Index Prop.	15% N Tasks	15% Index Prop.	20% N Tasks	20% Index Prop.
9	12	12	.65	468	344	.93	82	.18	317	.68	317	.75	406	.90
8	33	33	.91	574	534	.93	275	.48	472	.82	522	.91	553	.94
7	99	98	.97	589	570	.97	454	.77	573	.97	587	1.0	589	1.0
6	254	252	.99	596	582	.98	554	.93	596	1.0	596	1.0	596	1.0
5	398	399	.99	595	569	.96	576	.97	595	1.0	595	1.0	595	1.0
4	375	373	.99	596	582	.98	574	.96	596	1.0	596	1.0	596	1.0
3	79	79	.97	527	470	.89	421	.80	504	.96	521	.99	526	1.0
2	25	25	.90	375	280	.75	246	.66	325	.87	358	.95	370	.99
Total	1275	1271												

[a] The number of inventory tasks by pay grade (from total 597 tasks in ET inventory), excluding tasks score (0,0) (i.e, tasks not performed by any member in Sample A and B). Calculation of all stability indices was based on N in this column.

[b] A task was similar if percentage of MP between Samples A and B was not significantly different by Z-test (see page 5).

[c] A task was similar if percentage difference of MP between Sample A and B was within the value indicated--5, 10, 15, or 20. N Tasks is the number of Total N Tasks that were within percentage difference. Index Prop. is the proportion of inventory tasks (i.e., proportion of Total N Tasks) that were within percentage difference (see page 5).

Table F-3

Stability of Percent of Members Performing (MP)
Profile Across TM368 Samples (50% of Total Sample)

Pay Grade	N Incumbents Sample A	N Incumbents Sample B	r_{MP}	Total[a] N Tasks	Stability Indices: Tasks with Similar Percent of Members Performing by: Z-Difference[b] N Tasks	Z-Difference[b] Index Prop.	Percentage Point Difference Equal to or Less Than[c] 5% N Tasks	5% Index Prop.	10% N Tasks	10% Index Prop.	15% N Tasks	15% Index Prop.	20% N Tasks	20% Index Prop.
9	2	2	.25	158	146	.92	29	.18	29	.18	29	.18	29	.18
8	10	11	.75	273	240	.88	48	.18	122	.45	152	.56	216	.79
7	36	35	.93	323	303	.94	167	.52	267	.83	302	.93	316	.98
6	92	91	.96	336	312	.93	221	.66	314	.93	335	1.0	336	1.0
5	125	126	.98	337	332	.99	282	.84	332	.99	337	1.0	337	1.0
4	66	66	.96	332	299	.90	232	.70	307	.93	324	.98	331	1.0
3	29	28	.88	304	237	.78	173	.57	246	.81	284	.93	297	.98
2	8	8	.69	180	136	.76	44	.24	44	.24	149	.83	149	.83
Total	368	367												

[a] The number of inventory tasks by pay grade (from total 337 tasks in TM inventory), excluding tasks score (0,0) (i.e, tasks not performed by any member in Sample A and B). Calculation of all stability indices was based on N in this column.

[b] A task was similar if percentage of MP between Samples A and B was not significantly different by Z-test (see page 5).

[c] A task was similar if percentage difference of MP between Sample A and B was within the value indicated--5, 10, 15, or 20. N Tasks is the number of Total N Tasks that were within percentage difference. Index Prop. is the proportion of inventory tasks (i.e., proportion of Total N Tasks) that were within percentage difference (see page 5).

Table F-4

Stability of Percent of Members Performing (MP)
Profile Across YN1386 Samples (50% of Total Sample)

Pay Grade	N Incumbents Sample A	N Incumbents Sample B	r_{MP}	Total[a] N Tasks	Stability Indices: Tasks with Similar Percent of Members Performing by: Z-Difference[b] N Tasks	Z-Difference[b] Index Prop.	Percentage Point Difference Equal to or Less Than[c] 5% N Tasks	5% Index Prop.	10% N Tasks	10% Index Prop.	15% N Tasks	15% Index Prop.	20% N Tasks	20% Index Prop.
9	11	10	.74	458	445	.97	122	.27	222	.49	331	.72	385	.84
8	26	27	.90	467	406	.87	216	.46	333	.71	402	.86	444	.95
7	133	133	.98	515	490	.95	397	.77	500	.97	513	1.0	515	1.0
6	243	242	.99	528	499	.95	465	.88	528	1.0	528	1.0	528	1.0
5	340	340	.99	528	514	.97	509	.96	528	1.0	528	1.0	528	1.0
4	425	427	.99	528	496	.94	521	.99	528	1.0	528	1.0	528	1.0
3	153	152	.96	523	476	.91	459	.88	514	.98	522	1.0	523	1.0
2	55	54	.87	449	383	.85	331	.74	416	.93	435	.97	444	.99
Total	1386	1385												

[a] The number of inventory tasks by pay grade (from total 529 tasks in YN inventory), excluding tasks score (0,0) (i.e, tasks not performed by any member in Sample A and B). Calculation of all stability indices was based on N in this column.

[b] A task was similar if percentage of MP between Samples A and B was not significantly different by Z-test (see page 5).

[c] A task was similar if percentage difference of MP between Sample A and B was within the value indicated--5, 10, 15, or 20. N Tasks is the number of Total N Tasks that were within percentage difference. Index Prop. is the proportion of inventory tasks (i.e., proportion of Total N Tasks) that were within percentage difference (see page 5).

APPENDIX G

CLUSTER STABILITY RESULTS FOR RATING SAMPLE SIZE OF 1000

Table G-1

Stability and Common Membership of Matched Clusters
Across AD1000 Samples (50% of Total Sample)

	Correlational Index of Stability for Samples[a]				Percent Common Membership Index by:[b]	
	Total (A+B)	A vs. Total r_{TA}	B vs. Total r_{TB}	A vs. B r_{AB}	Time-Spent Assignment Method	Task-Performed Assignment Method
Cluster Id.	1	1	4			
Index		.99	.99	.97	88%	83%
N Tasks		351	334	335		
N Members	156	103	49		100/113	100/120
Cluster Id.	2	11	AC1[c]			
Index		.83	.94	.70	31%	31%
N Tasks		313	304	292		
N Members	28	13	17		8/26	10/32
Cluster Id.	3	5	2			
Index		.97	.97	.92	84%	89%
N Tasks		293	293	280		
N Members	68	34	39		48/57	42/47
Cluster Id.	4	2	5			
Index		.98	.85	.80	32%	9%
N Tasks		392	397	399		
N Members	184	92	32		8/25	4/46
Cluster Id.	5	7	6			
Index		.86	.91	.73	28%	29%
N Tasks		317	352	353		
N Members	25	44	29		8/29	16/55
Cluster Id.	6	3	1			
Index		.98	.99	.96	91%	91%
N Tasks		320	330	333		
N Members	173	71	97		136/150	140/154
Cluster Id.	7	6	3			
Index		.96	.95	.96	93%	92%
N Tasks		316	341	347		
N Members	63	45	51		70/75	86/93
Cluster Id.	8	8	8			
Index		.93	.99	.93	85%	72%
N Tasks		264	273	265		
N Members	111	20	69		90/106	56/78
Cluster Id.	9	9	AC2[c]	AC3[c]		
Index		.97	.77	.85 .65 .76	70%	90%
N Tasks		172	175	273 274 158		
N Members	21	15	5	6	16/23	18/20
Cluster Id.	10	10	9			
Index		1.00	.99	.99	93%	92%
N Tasks		233	237	240		
N Members	29	109	115		140/150	120/130
Cluster Id.	11	13	11			
Index		.96	.98	.93	84%	88%
N Tasks		193	178	186		
N Members	41	21	20		36/43	38/43
Cluster Id.	12	12	13			
Index		.98	.96	.94	82%	87%
N Tasks		253	256	259		
N Members	66	24	36		28/34	42/48
Cluster Id.	13	14	7			
Index		.94	.75	.59	48%	28%
N Tasks		305	305	306		
N Members	32	28	12		32/67	16/57
Cluster Id.	14	16	14			
Index		.89	.77	.82	93%	86%
N Tasks		159	168	132		
N Members	35	22	11		62/67	38/44
Cluster Id.	15	15	12			
Index		.99	.97	.93	72%	67%
N Tasks		178	212	212		
N Members	64	31	47		42/58	36/54
Cluster Id.	16	17	15			
Index		.99	.97	.95	91%	95%
N Tasks		291	277	285		
N Members	65	39	29		52/57	56/59
Index Aver		.95	.92	.85		
Aver N Tasks		272	271	268		
Tot N Members	1167	711	664			
% of Sample	68%	71%	66%			
Tot % of Common Membership					81%	76%

[a] Procedures for calculations of r_{TA}, r_{TB}, and r_{AB} are described on page 7.

[b] Percent Common Membership values equal twice the number of personnel assigned in common to each cluster of a pair of matched clusters (*numerator*), divided by the total number of personnel assigned to the pair (denominator), multiplied by 100. The numerator and denominator appear under each percentage. Clusters labeled AC2 and AC3 were treated as one cluster in the calculation of the Percent Common Membership values. (See pages 7 and C-3 for further description of index).

[c] AC is an additional cluster selected from a second search of the sample solution. (See also pages C-2 and C-3).

Table G-2

Stability and Common Membership of Matched Clusters
Across YN1000 Samples (50% of Total Sample)

	Correlational Index of Stability for Samples[a]				Percent Common Membership Index by:[b]	
	Total (A+B)	A vs. Total r_{TA}	B vs. Total r_{TB}	A vs. B r_{AB}	Time-Spent Assignment Method	Task-Performed Assignment Method
Cluster Id.	1	8[c]	9			
Index		.89	.98	.86	68%[e]	58%[e]
N Tasks		265	186	265		
N Members	24	23	18		118/174	64/111
Cluster Id.	2	1	1			
Index		.98	.99	.97	81%	85%
N Tasks		499	501	503		
N Members	318	173	154		100/124	196/231
Cluster Id.	3	6	4[c]			
Index		.93	.99	.90	70%[e]	68%[e]
N Tasks		433	428	429		
N Members	129	43	70		114/164	162/237
Cluster Id.	4	3	2			
Index		.98	.96	.94	89%	91%
N Tasks		412	417	423		
N Members	79	34	63		208/233	190/208
Cluster Id.	5	AC1[d]	3			
Index		.91	.75	.82	—[f]	—[f]
N Tasks		339	430	405		
N Members	24	12	21			
Cluster Id.	6	8[c]	8			
Index		.93	.97	.89	38%[e]	47%[e]
N Tasks		351	345	310		
N Members	57	23	28		64/169	74/157
Cluster Id.	7	AC2[d]	5			
Index		.82	.90	.65	25%	19%
N Tasks		307	308	288		
N Members	27	9	11		34/137	22/116
Cluster Id.	8	5	7			
Index		.89	.88	.75	73%	65%
N Tasks		302	305	263		
N Members	26	11	11		216/297	148/229
Cluster Id.	9	4	4[c]			
Index		.88	.85	.83	3%[e]	20%[e]
N Tasks		330	399	414		
N Members	34	24	70		8/235	66/336
Cluster Id.	10	9	11			
Index		.98	.98	.94	94%	92%
N Tasks		373	384	390		
N Members	61	30	32		76/81	72/78
Index Aver		.92	.93	.85		
Aver N Tasks		361	370	369		
Tot N Members	779	382	478			
% of Sample	39%	38%	48%			
Tot % of Common Membership					58%	58%

[a] Procedures for calculations of r_{TA}, r_{TB}, and r_{AB} are described on page 7.

[b] Percent Common Membership values equal twice the number of personnel assigned in common to each cluster of a pair of matched clusters (numerator), divided by the total number of personnel assigned to the pair (denominator), multiplied by 100. The numerator and denominator appear under each percentage. (See pages 7 and C-3 for further description of index).

[c] The same cluster was allowed to be matched twice if certain criteria were met (See step 4, page C-2).

[d] AC is an additional cluster selected from a second search of the sample solution. (See also page C-3).

[e] Values are spuriously low due to the same cluster being included in more than one pair of matched clusters (See page C-4).

[f] Not calculated due to clerical error.

Table G-3

Stability of Matched Clusters
Across ET1000 Samples (50% of Total Sample)

	Correlational Index of Stability for Samples[a]			
	Total (A+B)	A vs. Total r_{TA}	B vs. Total r_{TB}	A vs. B r_{AB}
Cluster Id.	1	1	1	
Index		.96	.98	.96
N Tasks		566	472	563
N Members	255	154	138	
Cluster Id.	2	8	6	
Index		.91	.89	.85
N Tasks		412	411	245
N Members	75	14	12	
Cluster Id.	3	AC1[b]	3	
Index		.98	.97	.94
N Tasks		428	389	427
N Members	61	43	27	
Cluster Id.	4	5	2	
Index		.99	.99	.97
N Tasks		432	430	444
N Members	173	103	94	
Cluster Id.	5	AC2[b]	AC3[b]	
Index		.94	.90	.78
N Tasks		422	422	392
N Members	33	13	9	
Cluster Id.	6	6	5	
Index		.69	.85	.69
N Tasks		398	324	347
N Members	21	49	12	
Cluster Id.	7	3	8[c]	
Index		.88	.84	.87
N Tasks		362	504	507
N Members	23	22	106	
Cluster Id.	8	4	7	
Index		.97	.99	.95
N Tasks		578	572	580
N Members	418	131	198	
Cluster Id.	9	2	8[c]	
Index		.99	.99	.97
N Tasks		518	516	528
N Members	202	83	106	
Cluster Id.	10	9	10	
Index		.94	.98	.88
N Tasks		501	489	512
N Members	88	22	41	
Cluster Id.	11	7	4	
Index		.91	.87	.79
N Tasks		355	334	368
N Members	33	22	33	
Cluster Id.	12	13	12	
Index		.89	.95	.79
N Tasks		215	206	171
N Members	34	12	15	
Cluster Id.	13	15	13	
Index		.86	.98	.87
N Tasks		322	320	305
N Members	57	22	33	
Index Aver		.92	.94	.87
Aver N Tasks		424	415	415
Tot N Members	1473	690	824	
% of Sample	74%	69%	83%	

[a] Procedures for calculations of r_{TA}, r_{TB}, and r_{AB} are described on page 7.

[b] AC is an additional cluster selected from a second search of the sample solution. (See also page C-2 and C-3).

[c] The same sample cluster was allowed to be matched twice if certain criteria were met (See step 4, page C-2).

Table G-4

Stability of Matched Clusters
Across TM368 Samples (50% of Total Sample)

	Correlational Index of Stability for Samples[a]			
	Total (A+B)	A vs. Total r_{TA}	B vs. Total r_{TB}	A vs. B r_{AB}
Cluster Id.	1	1	1	
Index		.94	.99	.96
N Tasks		319	283	288
N Members	144	42	74	
Cluster Id.	2	3	7	
Index		.90	.72	.51
N Tasks		160	161	146
N Members	16	7	5	
Cluster Id.	3	[b]	2	
Index			.95	[b]
N Tasks			191	
N Members	11		8	
Cluster Id.	4	AC1[c]	AC2[c]	
Index		.96	.81	.70
N Tasks		337	302	269
N Members	39	25	6	
Cluster Id.	5	5	10	
Index		.99	.99	.97
N Tasks		305	305	298
N Members	142	57	70	
Cluster Id.	6	6	11	
Index		.99	.97	.94
N Tasks		237	245	252
N Members	53	31	25	
Cluster Id.	7	8[d]	8	
Index		.97	.96	.89
N Tasks		196	189	192
N Members	34	21	14	
Cluster Id.	8	8[d]	9	
Index		.79	.88	.64
N Tasks		202	186	199
N Members	11	21	8	
Cluster Id.	9	4	3	
Index		.97	.95	.86
N Tasks		169	173	166
N Members	27	15	11	
Cluster Id.	10	2	6	
Index		.75	.69	.63
N Tasks		234	135	223
N Members	12	32	5	
Cluster Id.	11	9	16	
Index		.93	.94	.80
N Tasks		150	146	140
N Members	15	8	8	
Cluster Id.	12	10	13	
Index		.98	.94	.74
N Tasks		246	286	337
N Members	34	20	16	
Index Aver		.92	.90	.79
Aver N Tasks		232	217	228
Tot N Members	538	279	250	
% of Sample	73%	76%	68%	

[a] Procedures for calculations of r_{TA}, r_{TB}, and r_{AB} are described on page 7.

[b] No sample B cluster could be found that met selection criteria. (See page 6 and page C-2 for selection criteria).

[c] AC is an additional cluster selected from a second search of the sample solution. (See also page C-1).

[d] The same sample cluster was allowed to be matched twice if certain criteria were met (See step 4, page C-2).

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